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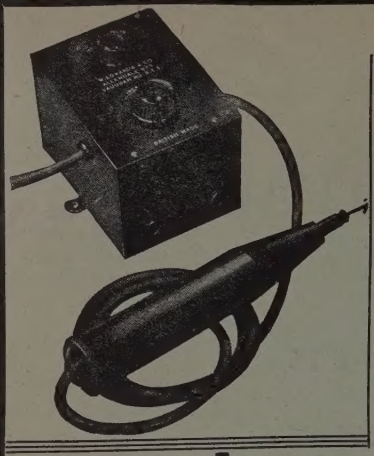

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## NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers. (An abridged version of the U.D.C. accompanies the Annual Index.) An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

Abstracts signed "E. R. A.," "M.-V.," "P. O." are supplied by courtesy of the British Electrical and Allied Industries Research Association, Metropolitan-Vickers Electrical Co. Ltd., and the Post Office Research Station respectively.

# MATHEMATICS 51

11.471 : 513.629.5 *see Abstr.* 648

12.831 646

**On a new reduction theorem of matrices.** GHOSH, J. N. *Bull. Calcutta Math. Soc.*, **37**, 33–6 (*June*, 945).—A method is given for expressing a rectangular natrix as the sum of a number of products of matrices f a certain kind. The reduction is closely related to he problem of factorizing the matrix, and the reduced orm is of physical significance [Abstr. 2544 (1944), 87 (1943)]. L. S. G.

12.831 : 531.36 *see Abstr.* 695

12.974 = 5 647

**Pseudo-extensors.** DE MIRA FERNANDES, A. *Portugaliae Mathematica*, **4** (*No.* 1) 41–51 (1943). *In Italian.*—In modern differential geometry it is important to have an extension of the notion of the ensor. Some general types of co-ordinate transformations are considered and, with reference to these, co-variant and contravariant extensors and pseudo-extensors are defined. Various properties of these are established. L. S. G.

513.629.5 : 511.471 648

**The biaxial surfaces, and the equivalence of binary forms.** SEGRE, B. *Proc. Camb. Phil. Soc.*, **41**, 187–209 (*Oct.*, 1945).—Two given binary forms are said to be equivalent when there exist linear substitutions transforming one form into the other; and the problem is to determine all such substitutions. A general and simple solution of the problem of equivalence, in the complex domain, is obtained by a geometric method. If $f(x, y)$ and $f_1(x_1\ y_1)$ are any two binary forms, each of degree $n$, the equation $f(x, y) = f_1(x_1, y_1)$ represents a surface of order $n$ in the space where $(x, y, x_1, y_1)$ are homogeneous co-ordinates. It is called a biaxial surface and the lines $x = y = 0$ and $x_1 = y_1 = 0$ are its axes. The problem of equivalence of $f$ and $f_1$ is the problem of deciding whether this surface contains any lines skew to its axes and, if so, of finding these lines. In an introductory section the parabolic, flecnodal and asymptotic curves upon an analytic surface are studied. Then the asymptotic curves upon the tetrahedral surfaces (particular biaxial surfaces) are investigated. Various algebraic results relating to binary forms are given, including information about invariants and co-variants. The biaxial surfaces are then studied in detail, using the results of the preceding sections, and their various geometric properties are investigated. The results are applied to the problem of equivalence of binary forms, in particular, cubic and quartic forms. The problem of canonical forms (related to that of equivalence) is briefly studied in the case of quartic forms. L. S. G.

513.77 : 513.813 649

**Projective collineations in a space of *K*-spreads.** CLARK, R. S. *Proc. Camb. Phil. Soc.*, **41**, 210–23 (*Oct.*, 1945).—The projective geometry of *K*-spreads is studied, including the projective connection and the projective derivative. The Lie derivative is defined and some of its properties are obtained. Previous results for collineations in a projective space of paths are generalized and improved by using the Lie derivation. The conditions are obtained for the equivalence of two projective spaces of *K*-spreads. [See Abstr. 2524 (1944)]. L. S. G.

513.813 : 513.77 *see Abstr.* 649

513.835 = 3 650

**A mapping theorem for Euclidean space.** HADWIGER, H. *Portugaliae Mathematica*, **4** (*No.* 3) 140–4 (1944). *In German.*—A $\Delta$-set in $R^n$ is defined and a proof is given of the theorem that if $R^n$ is covered by $n + 1$ closed sets then at least one of the sets is a $\Delta$-set. L. S. G.

513.835 = 3 651

**A generalization of well-known mapping and covering theorems.** HOPF, H. *Portugaliae Mathematica*, **4** (*No.* 3) 129–39 (1944). *In German.*—The mapping theorem of Borsuk–Ulam states that if $f_1, \ldots, f_n$ are continuous real functions upon the $n$-dimensional sphere $S^n$ in $n$-dimensional Euclidean space $R^n$, there exists a pair of diametrically opposite points $(x, x')$ such that $f_i(x) = f_i(x')$ for $i = 1, \ldots, n$. This and two related theorems are generalized and proofs are given. Some similar topological mapping theorems are discussed in an appendix. L. S. G.

513.881 = 4 652

**On spaces with a weak metric.** RIBEIRO, H. *Portugaliae Mathematica*, **4** (*No.* 1) 21–40 *and* 65–8 (1943). *In French.*—Various theorems on the topology of such spaces are proved. Semi-continuous functions in the space are defined and their properties are investigated. Necessary and sufficient conditions are given in order that a space possess a weak metric. L. S. G.

517.384 = 5 653

**On the passage to the limit under the integral sign.** FICHERA, G. *Portugaliae Mathematica*, **4** (*No.* 1) 1–20 (1943). *In Italian.*—Some criteria are given for the uniform summability of a sequence of functions, $\{F_n(P)\}$, in a domain $E$ of finite or infinite measure. When the sequence converges to $F(P)$ conditions are found under which

$$\lim_{n\to\infty}\int_U F_n(P)dT = \int_U F(P)dT$$

for all measurable domains $U$ of $E$. A proof is given of a theorem of Carathéodory on summability. L. S. G.

517.397.1 = 3 654

**On left- and right-Stieltjes' integrals and their applications.** SCHÄRF, H. *Portugaliae Mathematica*, **4** (*No.* 2) 73–80 (1943), (*No.* 3) 81–118 (1944). *In German.*—Some properties of functions of limited fluctuation are discussed and then the theory of left-

and right-Stieltjes' integrals is developed thoroughly. Various existence theorems are proved and the properties of iterated integrals are investigated. The application consists of the mathematical formulation of the theory of life-assurance. L. S. G.

517.5 = 5 655

**Continuous functions upon a spherical surface.** DE MIRA FERNANDES, A. *Portugaliae Mathematica*, 4 (*No.* 2) 69–72 (1943). *In Italian.*—A generalization is made of a theorem due to Kakutani [*Ann. Mathematics*, **43**, 739 (1942)]: If $f(P)$ is a real continuous function, defined upon a spherical surface $S^2$ of space $R^3$, and $O$ is the centre of the sphere and $\lambda(< 2\pi/3)$ is any positive number, there exist, upon $S^2$, three points $P_1$, $P_2$, $P_3$ such that the angles between the vectors $\overrightarrow{OP_1}$, $\overrightarrow{OP_2}$ and $\overrightarrow{OP_3}$ are each equal to $\lambda$ and $f(P_1) = f(P_2) = f(P_3)$. L. S. G.

517.942.7 = 4 656

**On Rodrigues' formula.** GONÇALVES, J. V. *Portugaliae Mathematica*, 4 (*No.* 1) 52–64 (1943). *In French.*—A study is made of the solutions of $Ay'' + By' + cy = 0$ where $A = a_0x^2 + a_1x + a_2$, $B = b_0x + b_1$, $c = \text{const.}$, on the assumption that the equation $a_0\xi(\xi - 1) + b_0\xi + c = 0$ has a positive integer $n$ as one of its roots. It is shown that if $N$ is an arbitrary polynomial, of degree at most $n$, and $\Phi = \int BA^{-1}dx$, then

$$y = Ae^{-\Phi}\frac{d^n}{dx^n}\left[e^{\Phi}A^{n-1}\{d + \int e^{-\Phi}A^{-n}Ndx\}\right]$$

satisfies the equation, and this reduces to Rodrigues' formula when $d = 1$, $N \equiv 0$. Then $y$ is a polynomial in $x$ of degree at most equal to $n$. The case where Rodrigues' formula fails (namely when $e^{\Phi}A^{n-1}$ is a polynomial of degree less than $n$) is examined and it is shown that polynomial solutions are still obtainable. Conditions for the existence of two polynomial solutions are found. L. S. G.

517.947.44 : 534.121.1 657

**The Fourier transform solution of an elastic wave equation.** SNEDDON, I. N. *Proc. Camb. Phil. Soc.*, **41**, 239–43 (*Oct.*, 1945).—Previous analysis relating to the equation governing the symmetrical vibrations of a thin elastic plate [Abstr. 1739 (1945)] is here extended to the case where no symmetry exists. A double Fourier transform is now necessary instead of a Hankel transform. Two examples are given. Forced and free vibrations are considered. L. S. G.

517.948.32 : 539.152 658

**On an integral equation associated with the equation for hydrogen atom.** BOSE, S. N. *Bull. Calcutta Math. Soc.*, **37**, 51–61 (*June*, 1945).—Let $\phi$ be a Schrödinger function characterizing a stationary state of the hydrogen atom. The associated function, $M$, used in defining probability in momentum space, is given by

$$\phi = \int M(l, m, n) \exp 2\pi i(lx + my + nz)dldmdn$$

An integral equation for $M$ is set up and solved completely and expressions for $M$ are obtained which are at once applicable to physical problems. L. S. G.

519.2 659

**Lognormal distributions.** ALLEN, P., PEARCE, S. C., AND GADDUM, J. H. *Nature, Lond.*, **156**, 746–7 (*Dec.* 22, 1945).—[See Abstr. 12 (1946)].

519.21 = 3 660

**The probability of rare happenings.** FINSLER, P. *Experientia*, **1**, 56–7 (*May* 15, 1945). *In German.*

519.21 : 621.791.75 : 621.316.15.016.33 = 4 661

**Application of the theory of probability to distribution networks of electric or fluid energy. (Feeding several electric arc-welding stations.)** VOLFF, C. *Rev. Gén. Élect.*, **54**, 122–4 (*April*, 1945). *In French.*—[Abstr. 547 B (1946)].

519.241.1 : 551.582.2 = 3 *see Abstr.* 919

519.48 = 4 662

**Abstract hyperelliptic fields of characteristic two.** ANCOCHEA, G. *Portugaliae Mathematica*, 4 (*No.* 3) 119–28 (1944). *In French.*—Three cases are considered: 1. Three distinct points of ramification; 2. Two coincident points different from the third; 3. Three coincident points. In each case the normal forms of the equations representing the fields are given together with the invariants and automorphisms. The normal forms are: 1. $y^2 - (x^2 - x)y = \lambda x^5 + \mu x^3 + \nu x$; 2. $y^2 - xy = \lambda x^5 + \mu x^3 + x$; 3. $y^2 - y = x^5 + \mu x^3$. In case 3 there are two groups of automorphisms, consisting of 32 and 160 elements respectively. The structure of these groups is determined. L. S. G.

519.53 663

**Additive functions of intervals and Hausdorff measure.** MORAN, P. A. P. *Proc. Camb. Phil. Soc.*, **42**, 15–23 (*Jan.*, 1946).—The Hausdorff measure, $h - mE$, of a set $E$, in a Euclidean space, $R^q$, relative to a function $h(t)$ is defined, and some properties of the measure are noted. Necessary and sufficient conditions, in order that $h - mE$ be greater than zero, are established in terms of the existence of a certain additive function of intervals. The theorem, which is an extension of an earlier one [*Proc. Camb. Phil. Soc.*, **33**, 419 (1937)], is used to determine the dimensional number of a class of sets generalizing Cantor's ternary set. Some theorems are also given on the measures of plane sets which are the products of linear sets of fractional dimension, and similar results hold for cylinder and product sets in three dimensions. L. S. G.

# ASTRONOMY . GEODESY 52

523.1 = 4 664

**On the mathematical and physical significance of the cosmological constant λ.** DRUMAUX, M. P. *Ann. Soc. Sci. Brux.*, **60**, 80 (*May* 15, 1945). *In French.*—The constant $\lambda$ plays a very different part in the various relativistic theories of the universe. It is here shown that $\lambda$ is not a universal constant but merely a constant of integration corresponding to the limits imposed in

a gravitational problem studied by means of the tensor field equations. In the problem of the structure of the universe $\lambda$ may be assumed zero. L. S. G.

523.11 = 3 665

**Modern cosmogony.** V. D. PAHLEN, E. *Experientia*, 1, 36–50 (*May* 15, 1945). *In German.*—The author gives a non-mathematical account of the following subjects: The classification into types and the structure of extra-galactic nebulae; the distribution in the Russell diagram of the stars and their characteristics; the formation of solar planets. The third of these items forms the main substance of the paper. After referring to the work of Jeans and others on rotating compressible spheres, Weizsäcker's new theory of "accretion on vortices" is described at length [see *Observatory*, **66**, 112–15 (Aug., 1945)]. Finally, a short account is given of the recession of the extra-galactic nebulae. G. C. McV.

523.72 : 535.231 : 621.396.821 666

**Solar radiations in the 4–6 m radio wavelength band.** HEY, J. S.; STRATTON, F. J. M. *Nature, Lond.*, **157**, 47–8 (*Jan.* 12, 1946).

523.746 667

**Provisional sunspot-numbers for March–June, 1945.** BRUNNER, W. *Terr. Magn. Atmos. Elect.*, **50**, 198 (*Sept.*, 1945).

523.746 668

**Final relative sunspot-numbers for 1944.** BRUNNER, W. *Terr. Magn. Atmos. Elect.*, **50**, 231–2 (*Sept.*, 1945).

523.746 669

**Provisional sunspot-numbers for July–September, 1945.** BRUNNER, W. *Terr. Magn. Atmos. Elect.*, **50**, 319 (*Dec.*, 1945).

523.83/.85 670

**Reports on the progress of astronomy: stellar dynamics.** CHANDRASEKHAR, S. *Mon. Not. R. Astr. Soc.*, **105** (*No.* 2) 124–34 (1945).—The first problem discussed is that of stellar encounters as a two-body problem. It is shown that the theory can be treated as a generalized Brownian motion on the basis of a dynamical friction together with a process of diffusion. Applied to the Pleiades, the mean life of this cluster proves to be $3 \times 10^9$ years. The second problem is that of the consequences for dynamical theory of the observed kinematics of stellar motions. These motions can be analysed into a field of differential motions and the phenomenon of star-streaming. It is proved that for steady states of systems of finite extent, the gravitational potential must have axial symmetry. Lastly, the problem of multiple stellar encounters is discussed. The fluctuation in the stellar distribution whose gravitational potential affects a given star is assumed to be restricted to providing a constant average number of stars per unit volume. The stars also trace out linear trajectories independently of each other. The statistics of the fluctuating gravitational field are worked out and applied to the problem of the time of dissolution of binary systems. This again leads to a time-scale of order $3 \times 10^9$ years. G. C. McV.

523.841.11 671

**B Cassiopeiae as a supernova of Type I.** BAADE, W. *Astrophys. J.*, **102**, 309–17 (*Nov.*, 1945).—The light-curve of this nova of 1572 is determined from Tycho Brahe's observations and those of his contemporaries. The light-curve and the variations of colour show that the outburst was that of a supernova of Type I with a maximum apparent magnitude of −4·0. A characteristic feature of Type I is the linear decrease in brightness which sets in at about 120 days after maximum; another is that the star reddens for a time during decreasing brightness. Both features are exhibited by Tycho's star. B Cassiopeiae is the third Type I supernova observed in our galaxy in the last 900 years; since it shows no observable expanding shell, it is probably further on towards the white-dwarf stage than are the other two supernovae of A.D. 1054 and 1604. G. C. McV.

523.842 = 4 672

**The problem of the double-stars.** TIERCY, G. *Experientia*, **1**, 127–36 (*Aug.* 15, 1945). *In French.*—A non-technical account is given of the methods of observing double-stars and of calculating their orbits. Visual, spectroscopic and eclipsing binaries are reviewed in turn. The mass-luminosity law is based observationally on these stars. The author points out that the study of binaries provides no conclusive evidence for the constancy of the velocity of light. All the relevant phenomena can also be accounted for by assuming that light-waves are ellipsoidal in form. G. C. McV.

523.852 673

**A study of general and selective absorption in four small dark nebulae.** STODDARD, L. G. *Astrophys. J.*, **102**, 267–80 (*Nov.*, 1945).—The areas are B34, 201, 226, 227 of Barnard's list and the absorption was studied by star counts in the dark nebulae and in the surrounding normal regions, both photographically and photovisually. Attempts were made to describe the situation in the normal regions by means of a constant density function and uniform absorption, but no unique solution could be found. Trial and error was therefore employed to determine these quantities in each region and then the absorbing power of each cloud was found by assuming that the dark cloud was of negligible extent in depth and that the true star density was the same in the direction of the nebula as in the surrounding field. All four clouds showed selective absorption, the mean ratio of photographic to visual magnitude being 1·31. The distances of the clouds are not greater than 1 000 parsecs and so these objects are comparable with the Orion nebula. The absorption coefficients are at least of the order of 0·2 parsecs within the clouds. G. C. McV.

527.1.088 674

**The probability distribution around a fix in celestial navigation.** DEUTSCH, A. J. *Amer. J. Phys.*, **13**, 379–83 (*Dec.*, 1945).

# PHYSICS 53

53.085.422 : 681 = 4 675

**Apparatus for the photographic reproduction of scales on metallic cylinders.** *Rev. Opt. (Théor. Instrum.)*, **22,** 101–2 (*April–June*, 1943). *In French.*—The cylinder is coated with a light sensitive emulsion and supported vertically against a slab of glass engraved with the desired scale. Rotation of the cylinder causes the scale to move past. Illumination is by means of a Hg lamp and cylindrical lens. The process is claimed to be one of high speed and convenience where the greatest accuracy is not required. A. H.

## FUNDAMENTALS 530.1

530.1 : 539.15 *see Abstr.* 825

530.12 676

**On a type of kinematical "Red-Shift."** HILL, E. L. *Phys. Rev.*, **68,** 232–3 (*Nov.* 1 *and* 15, 1945).

530.145 677

**Field concepts in quantum theory.** BECK, G. *Rev. Mod. Phys.*, **17,** 187–94 (*April–July*, 1945).—A general discussion is given of various physical pictures which have been formulated in a description of the microstructure of matter and radiation. Dirac's equation is taken firstly in the form

$$p_0 + \boldsymbol{\alpha}\mathbf{p} + \beta mc = 0$$

and it is pointed out that two interpretations are possible. Firstly $p_i$ are taken as canonical variables and $\boldsymbol{\alpha}$ and $\beta$ are a formal means of making the equation linear. Secondly the velocity concept is introduced and the equation is written in the form

$$\{-c^{-1}\partial/\partial t + \boldsymbol{\alpha}\,\mathrm{grad} + i\beta\Lambda^{-1}\}\Psi = 0$$

Now the operators $\boldsymbol{\alpha}$ and $\beta$ are taken as kinematical variables, and, to make the field variables show up explicitly, the use of canonical variables is eliminated. Kinematical quantities, given by certain bilinear forms derived from Dirac's equation, are interpreted physically and their transformation laws are discussed. L. S. G.

530.145 678

**On the strong coupling case for spin-dependent interactions in scalar- and vector-pair theories.** PAULI, W., AND HU, N. *Rev. Mod. Phys.*, **17,** 267–86 (*April–July*, 1945).—Spin-dependent interactions have been treated until now only (by a perturbation method) in the case of weak coupling. The strong coupling case is now investigated for the scalar theory and the vector theory. In the first case the interaction of one nucleon with the meson field is assumed to be

$$H = 4\pi f\sigma i[I \times J] + 4\pi g I \,.\, J$$

where

$$I = \int U(x)\nabla\phi^*(x)dx \qquad J = \int U(x)\nabla\phi(x)dx$$

Here $U(x)$ is the source function, $\phi(x)$ a complex scalar field describing charged particles with spin 0, $f$ and $g$ are coupling constants and $\boldsymbol{\sigma}$ is the spin of the nucleon. The method involves splitting the Hamiltonian into three parts, $H_0$, $H'$ and $\Omega$. $H_0$ gives no interaction between nucleons, $H'$ gives the main result of the paper, namely a formula for the interaction energy, which shows that this energy is spin independent if the criterion for strong coupling is fulfilled. $\Omega$ is treated as a perturbation energy in the strong coupling case and gives a contribution to the interaction energy of smaller order of magnitude than that due to $H'$. A similar method is used in the case of the vector-pair theory, in which a pair of mesons with spin 1 and opposite charge interacts with the nucleons. L. S. G.

530.145 679

**On the elimination of divergencies in quantum field theory.** GUSTAFSON, T. *K. Fysiogr. Sällsk. Lund Förh.*, **15** (*No.* 28) 12 *pp.* (1945).—Using Riesz's mathematical method of resolving the wave equation the theory of quantum electrodynamics is discussed, assuming the theory, due to Dirac [Abstr. 1742 (1942)] of positive- and negative-energy photons. The Compton effect is studied since this is a simple problem where divergencies appear [Abstr. 2852 (1934)] when ordinary quantum electrodynamics is used. The electrons are treated by quantization of electron waves and the Heisenberg picture (matrices varying with time, and state vector fixed) is used. In the problem of a photon colliding with an electron the transition probability from one state to another is calculated, the matrix equations for the electron waves and the field being resolved by successive approximation. The first, second and third approximations are considered. The methods of Wentzel and Dirac give divergence-free solutions to the problem but lead to difficulties when assuming the hole theory. These difficulties do not arise in the present method. L. S. G.

530.145 680

**On the analogy between classical and quantum mechanics.** DIRAC, P. A. M. *Rev. Mod. Phys.*, **17,** 195–9 (*April–July*, 1945).—A method is given for defining general functions of non-commuting observables in quantum mechanics, with a certain limitation. The method is developed to provide a formal probability for non-commuting observables to have numerical values. This probability is in general a complex number, but has some physical meaning, since when it is close to zero one can say that the numerical values are unlikely. The method enables one to discuss trajectories for the motion of a particle in quantum mechanics and thus makes quantum mechanics more closely resemble classical mechanics. It also enables the analogy between classical and quantum contact transformations to be set up on a more general basis.

530.145 681

**Comments on the difficulties of the meson theory.** HULTHÉN, L. *Rev. Mod. Phys.*, **17,** 263–6 (*April–July*, 1945).—The symmetrical form of the meson theory suffers from well-known disadvantages, but is supported by its ability to explain the saturation of heavy nuclei, and by its prediction of equality of neutron-proton and neutron-neutron forces in corresponding stages ("charge independence hypothesis"). New measurements, however, throw doubt on the experimental basis of the latter, and the author considers whether an unsymmetrical theory, where neutral and

charged mesons are described by different kinds of fields, can overcome some of the difficulties of the meson theory at the price of abandoning the charge independence hypothesis.

530.145 682

**On the singlet and triplet state of the deuteron in the meson pair theory.** BRULIN, O., AND HJALMARS, S. *Ark. Mat. Astr. Fys.*, **32 A** (*Paper* 7), 10 *pp.* (1945).—Using Klein's expression [Abstr. 2458 (1944)] for the term in the Hamiltonian corresponding to the mutual interaction between two nuclear particles, an estimation is made of the interaction constant, $\gamma$, the cutting-off distance and the sign and order of magnitude of the quadrupole moment of the deuteron. Thus the singlet scattering of neutrons and protons by protons and the ground state of the deuteron are investigated. The cutting-off distance is determined by numerically integrating inwards the Schrödinger equation for given values of $\gamma$. Asymptotic solutions provide the starting point, and the integration is carried out until the cutting-off distance is reached. The value $\gamma = 2$ seems plausible from the singlet calculation and this value, corresponding to a cutting-off distance in the triplet state of 0·19, gives the right sign of the quadrupole moment but a value which is about ten times less than the experimental one.

L. S. G.

530.145 683

**Fourier transforms of retarded and advanced potentials.** MA, S. T. *Phys. Rev.*, **68**, 166–72 (*Sept.* 1 *and* 15, 1945).—The Fourier transforms of the retarded and advanced potentials of the electromagnetic field and of the wave fields of elementary particles are obtained with the help of the invariant functions of Jordan, Pauli and Dirac, together with their generalizations. It is shown that the Fourier transforms of these potentials are closely related to those of the outward and inward moving waves given by Dirac for the scattering problems in quantum mechanics, and their connection is discussed. It is also shown that there exists a type of potentials which represents waves with frequencies of opposite signs propagating in opposite directions.

530.145 684

**On the theory of the electron and of the nucleon.** PAIS, A. *Phys. Rev.*, **68**, 227 (*Nov.* 1 *and* 15, 1945).

530.145 : 535.14 685

**On the interaction of radiation and matter.** HAVAS, P. *Phys. Rev.*, **68**, 214–26 (*Nov.* 1 *and* 15, 1945).—The quantum theory of radiation describes the effect of retardation in the interaction of two charged particles by the mutual emission and absorption of light quanta. The method used in a previous paper [Abstr. 159 (1945)] on the interaction of radiation and two particles is extended and applied to a process involving the interaction of any number of charged particles (obeying Dirac's equation) and light quanta. It is shown that in the usual first-order approximation of perturbation theory the resulting expression for the interaction of two free particles obtained by summing over all the intermediate states involving virtual quanta is of the same form for any process. By carrying the summation one step further it is shown that this expression reduces to Møller's formula. The results are relativistically invariant in spite of the usual omission of divergent terms in the Hamiltonian.

530.145 : 537.122 686

**The pair production of light mesons by electrons.** FESHBACH, H., AND TISZA, L. *Phys. Rev.*, **68**, 233 (*Nov.* 1 *and* 15, 1945).

530.145 : 537.122 = 4 687

**Present state of the theories of elementary particles and of quanta.** STUECKELBERG, E. C. G. *Experientia*, **1**, 33–6 (*May* 15, 1945). *In French.*—A general survey is given, in abstract mathematical terms, of the theories of electrodynamics which have been proposed to overcome the difficulty of the infinite "self-energy" of the electron in the Lorentz theory. The related theory of the quantum of energy is also discussed.

G. C. McV.

530.145 : 537.227 : 548.7 688

**On the quantum theory of pyroelectricity.** BORN, M. *Rev. Mod. Phys.*, **17**, 245–51 (*April–July*, 1945).—The problem solved is part of the author's general revision of lattice electrodynamics and lattice optics from the standpoint of quantum mechanics. It concerns the temperature ($T$) dependence of the pyroelectric moment, $M$. It was formerly found that $M$ followed a $T^4$ law, but the new application of quantum theory shows that $M$ follows a $T^2$ law for small $T$, and this is in agreement with experimental results. The denial by the Indian physicists (Raman and his collaborators) of the validity of the whole theory of lattice dynamics is criticized and the view is expressed that all the recent observations of these physicists may be explained by a lattice theory founded upon quantum mechanics.

L. S. G.

530.145 : 537.591 *see Abstr.* 809

530.145 : 539 *see Abstr.* 824

530.145.61 689

**Some integral theorems for eigenfunctions of a discrete spectrum.** HULTHÉN, L. *K. Fysiogr. Sällsk. Lund Förh.*, **15** (*No.* 22) 9 *pp.*, 1945.—It is shown that analogous integral relations to those considered for a continuous spectrum [Abstr. 492 (1945)] hold for a discrete spectrum. The process is illustrated by considering the equation

$$d^2\psi/dx^2 + \{\varepsilon + v(x)\}\psi = 0$$

and the generalization is illustrated by considering the Schrödinger equation for a system of two particles influenced by a central force. The integral relations occurring in the theory of the deuteron are also discussed.

L. S. G.

## MECHANICS OF SOLIDS 531

531.18 690

**On Mathisson's variational equation of relativistic dynamics.** SHANMUGADHASAN, S. *Proc. Camb. Phil. Soc.*, **42**, 54–61 (*Jan.*, 1946).—The equation was solved by Mathisson [Abstr. 506 (1942)] on the assumption that a certain vector vanishes. This assumption is now removed and a solution is obtained by Mathisson's methods with a generalization at one

stage. This consists in replacing a certain tensor with three independent components, by an anti-symmetric tensor, with six independent components. The solution gives two equations describing the translational motion and the rotational motion. The rotational equation is investigated by setting up a variational equation based upon the conservation of angular momentum, and this proves to be of the same form as that obtained from Mathisson's variational equation. L. S. G.

531.19 : 532.517.4 *see Abstr.* 704

531.224 : 624 = 3 691

**Diagrams and method for calculating elastically supported beams with any loading.** MANGER, A. *Schweiz. Bauztg*, **125**, 125–8 (*March* 17); 137–40 (*March* 24); 165–8 (*April* 7, 1945).—[Abstr. 688 B (1946)].

531.252.2 692

**Problems of thin plates with circular holes.** SEN, B. *Bull. Calcutta Math. Soc.*, **37**, 37–42 (*June*, 1945).—The problems solved are those of finding the stresses in an infinite plate when either a force in the plane of the plate or a couple with its axis normal to the plate acts at a point outside a circular hole, not far from its centre. L. S. G.

531.258 = 3 693

**Approximate calculation for a plate constrained on three edges.** STRAUB, H. *Schweiz. Bauztg*, **126**, 125–7 (*Sept.* 22, 1945). *In German.*—The elastic deformation of a rectangular plate with one edge free and subject to pressure on one side is important in the construction of reservoirs, etc., but the exact solution of the differential equation is difficult. The function

$$w = 4w_{max}\left\{\left(\frac{x}{a}\right)^2 - 2\left(\frac{x}{a}\right)^3 + \left(\frac{x}{a}\right)^4\right\} \times \left\{4 - 5\left(\frac{y}{b}\right) + \left(\frac{y}{b}\right)^5\right\}$$

where $w$ is the displacement of the point $(x, y)$ and $a$ and $b$ are the width and depth of the plate, satisfies the boundary conditions and is proposed as an approximate solution. The maximum displacement of the free edge, $w_{max}$, is calculated by equating the elastic strain energy to the work done by the external pressure for two cases, pressure uniform, and pressure proportional to depth. Tables to facilitate the calculation of the bending moments are given for various values of the ratios $a/b$, $x/a$, $y/b$. A. J. C. W.

531.259.1 = 3 694

**On a graphical representation of the strained states of a solid.** MELDAHL, A. *Schweiz. Arch. angew. Wiss. Tech.*, **10**, 269–74 (*Sept.*, 1944). *In German.*—The three principal stress coefficients are used as rectangular co-ordinates in space and for any material the states of stress are represented by the points of a surface which is characteristic of the material. This applies to isotropic or anisotropic materials. But a space representation (involving the use of a model of the surface) is not so convenient as a plane representation. The latter may be obtained by a suitable projection of the surface and two methods for doing this are considered. In one, contour lines are obtained, and in the other, meridian curves provide the representation. Examples are given. L. S. G.

531.36 : 512.831 695

**Matrix treatment of a rigid body motion in complex space.** GHOSH, N. N. *Bull. Calcutta Math. Soc.*, **37**, 43–50 (*June*, 1945).—An extension to complex space of previous work [Abstr. 2544 (1944)] on the motion in a Euclidean $n$-space. Complex vectors are represented by means of Hermitian matrices (of a certain type), which play a dominant part in the theory. The kinetic energy, magnitude of angular velocity, the moment of a couple and the work done by a force or a couple are all defined by real quantities. L. S. G.

531.39 696

**Nonlinear springs.** SADOWSKY, M. A. *J. Franklin Inst.*, **240**, 469–76 (*Dec.*, 1945).

531.5 = 4 697

**On the universal relation between distance and mass.** DRUMAUX, M. P. *Ann. Soc. Sci. Brux.*, **60**, 73–9 (*May* 15, 1945). *In French.*—The relation associates with each mass $m$ a length $l$, given by $l = 2Km/c^2$ where $K$ is the Newtonian constant and $c$ is the velocity of light; and conversely, with each length $l$ a mass $m$ given by $m = c^2l/2K$. This relation is discussed in conjunction with previous work by the author. It is deduced uniquely from the general tensor equations of the gravitational field. L. S. G.

531.57 698

**Simplified equations of interior ballistics.** MAYER, J. E., AND HART, B. I. *J. Franklin Inst.*, **240**, 401–11 (*Nov.*, 1945).—The equations are presented subject to the assumptions of zero starting pressure, covolume equal to charge volume, burning rate proportional to pressure, constant burning surface, and no heat loss through gas or projectile friction. The expressions for the maximum pressure and muzzle velocity are discussed, and the derivatives with respect to various parameters are given.

531.66 : 621.974.1 699

**Theory of forging hammers and their foundation.** ANDREWS, W. C., AND CROCKETT, J. H. A. *Trans. Instn Engrs Shipb. Scot.*, **89**, 53–104 (*Dec.*, 1945).—[Abstr. 686 B (1946)].

## MECHANICAL MEASUREMENTS 531.7

531.754 700

**Apparatus for measurement of the density of porous solids.** KRIEGER, K. A. *Industr. Engng Chem. (Analyt. Edit.)*, **17**, 532 (*Aug.*, 1945).—An apparatus previously described [Abstr. 110 (1945)] for surface area measurement was found to be convenient for measurement of densities of porous solids with He as the displaced fluid.

## MECHANICS OF LIQUIDS 532

532.122 : 536.632 701

**The isothermal and adiabatic compressibilities of oil.** CAMERON, A. *J. Inst. Petrol.*, **31**, 421–7 (*Nov.*, 1945).—The work published on both the isothermal and adiabatic compressibilities of oils is considered and

verage curves are given for both compressibilities over a range of temperatures. The ratio isothermal/adiabatic compressibility equals the ratio of the specific heats, $\gamma$, which is shown to be 1·135 for mineral oils.

532.13 : 668.31 : 620.172.212 702

**Physical testing of glue compositions.** GRIFFIN, W. C., AND ALMY, E. G. *Industr. Engng Chem.*, **37**, 949–52 (*Oct.*, 1945).—[Abstr. 469 B (1946)].

532.5 : 536.7 703

**On the thermo-hydrodynamics of perfectly perfect fluids. II.** VAN DANTZIG, D. *Proc. Ned. Akad. Wet.*, **43** (*No.* 5) 609–18 (1940).—A continuation of previous work [Abstr. 1614 (1940)]. The equations describing chemical reactions are given and the mass-action law is obtained as a special case of the condition of isentropy. The equations of continuity for the different components in the absence of reactions are studied and various errors in the literature of relativistic hydro- and thermodynamics are pointed out. A symmetrical form for the equations of motion and continuity is obtained and the symmetry is further strengthened by the use of homogeneous variables.

L. S. G.

532.517.4 : 531.19 704

**Application of statistical mechanics to the theory of turbulent flow motion. A hypothesis which can serve as a basis for a statistical treatment of some mathematical model systems.** BURGERS, J. M. *Proc. Ned. Akad. Wet.*, **43** (*No.* 8) 936–45 (1940).—In continuation of preceding work [Abstr. 1714 (1940)] the author shows that difficulties encountered in that work, more especially in connection with its failure to lead to a "spectrum" of elementary components, can be removed by means of an additional hypothesis which describes in a schematic manner the influence of non-linear terms of the equations upon the distribution of weights over the phase space. J. S. G. T.

532.517.4 : 541.182.4 *see Abstr.* 869

532.582 705

**Virtual masses of rectangular plates and parallelepipeds in water.** YU, Y. T. *J. Appl. Phys.*, **16**, 724–9 (*Nov.*, 1945).—A report on experimental results obtained for the virtual masses of thin rectangular plates and rectangular parallelepipeds moving in water. Experimental data, together with an empirical equation, showing the manner in which the virtual mass of a rectangular plate varies with dimensions and direction of motion are given. Data and an empirical equation giving the virtual mass of a rectangular parallelepiped as a function of dimensions and direction of motion, for the special case in which the motion is parallel to one face, are also listed. [See Abstr. 1234, 2271 (1942)].

532.59 706

**On the reflexion of surface waves by a submerged plane barrier.** DEAN, W. R. *Proc. Camb. Phil. Soc.*, **41**, 231–8 (*Oct.*, 1945).—If the top edge of the barrier is at a depth $a$ below the surface the coefficient of reflexion is found to be about $^1/_4$ when $a = gT^2/80$, where $T$ is the period of the incident waves. Curves are given showing the variation, with $T$, of the coefficients of reflexion and transmission. L. S. G.

532.59 707

**On some cases of the reflexion of surface waves by an inclined plane barrier.** DEAN, W. R. *Proc. Camb. Phil. Soc.*, **42**, 24–8 (*Jan.*, 1946).—The reflexion of a simple harmonic train of waves is considered in the case where the barrier is inclined at an angle $\pi/2s$ to the undisturbed free surface of the water, $s$ being an integer. The solutions for $s = 1$ and $s = 2$ are known and the solution for any integral value of $s$ is now given. In the case $s = 3$ the form of the free surface is calculated and a graph is given of the function which gives the profile of the standing wave at any time. L. S. G.

532.61 : 541.183.1 708

**Change of surface tension with time. II. Surface tension of saponin solutions.** ROSS, S. *J. Phys. Chem.*, **49**, 377–86 (*July*, 1945).—Data for the change of surface tension with time in aqueous saponin solutions are interpreted on the basis of an autocatalytic reaction between molecules already sorbed on the surface and molecules captured by them from a layer just underneath. Results are in general conformity with such an explanation. N. M. B.

532.64 709

**The hysteresis of the angle of contact of mercury.** YARNOLD, G. D. *Proc. Phys. Soc., Lond.*, **58**, 120–5 (*Jan.*, 1946).—A dynamical method is described for the observation of the advancing and receding angles of contact of Hg at very low velocities. It is suggested that the irreversible part of the work expended when the line of contact of the liquid traverses the solid surface is different for the two directions of motion.

532.68 710

**Data on rate of capillary rise.** LEGRAND, E. J., AND RENSE, W. A. *J. Appl. Phys.*, **16**, 843–6 (*Dec.*, 1945).—General aspects of the dynamics of capillary rise are considered with references to extant theories. A stroboscopic method used to study the rise of a liquid in a capillary tube is discussed. Tables are presented showing the observed heights at various times during the rise for water, ethyl alcohol and glycol in each of three capillaries of different diameters. [See Abstr. 131 (1945)].

532.694.1 711

**The three-dimensional shapes of bubbles in foams.** MATZKE, E. B. *Proc. Nat. Acad. Sci. Wash.*, **31**, 281–9 (*Sept.*, 1945).

532.712 : 541.24 712

**Bacterial cellulose for osmometer membranes.** MASSON, C. R., MENZIE, R. F., CRUICKSHANK, J., AND MELVILLE, H. W. *Nature, Lond.*, **157**, 74 (*Jan.* 19, 1946).

532.72 : 535.324.2 713

**Note on the refractometric measurement of concentration gradients by using cylindrical tubes.** LAMM, O. *Ark. Kemi Min. Geol.*, **16 B** (*No.* 5) *Paper* 17, 7 *pp.* (1943).—The optical conditions for the measurement of concentration gradients—e.g. in studying the diffusion of liquid binary mixtures in general—by

refraction methods, especially the scale method, were examined for the case of a cylindrical tube. A certain diffusion column should be measured either in an ordinary cylindrical tube or in a tube with planed outer surfaces, the right choice depending upon the refractive index of the liquid inside and outside the tube. The measurement requires a low aperture and it is preferable to use short scale lines or better a series of points instead of lines. In critical regions of the refractive indices the use of quite narrow slit diaphragms, limiting the light path through the tube, is unavoidable.

532.739.2 : 541.133 *see Abstr.* 863

## MECHANICS OF GASES 533

533.15 : 537.54 : 545.827 *see Abstr.* 878

533.275 : 621.315.612 : 537.226.8 *see Abstr.* 789

533.56 714

**Use of silicones as diffusion pump oils.** BROWN, G. P. *Rev. Sci. Instrum.*, **16**, 316–18 (*Nov.*, 1945).—Comparative performances of Litton C, Octoil, Narcoil and two typical silicones in a non-fractionating diffusion pump are presented with a discussion of v.p., stability to heat and oxidation, and the ability to operate against high forepressures. Extrapolated v.p., temperature data, and test results show the high boiling silicone to produce the highest vacuum as indicated by an untrapped ionization gauge. The silicone was further found to be nearly completely resistant to oxidation when exposed to air while hot. A table shows the relative merits of various oils, as applied to vacuum pumping conditions ordinarily encountered.

533.6.01 715

**Air flow separation at high speed.** KORVIN-KROUKOVSKY, B. V. *J. Franklin Inst.*, **240**, 477–85 (*Dec.*, 1945).—The resistance coefficient of a body moving in a fluid depends on Reynolds number $R$, Mach number $M$ and the parameter $gL/U^2$, which is customarily neglected in view of small weight of the air. Here $L$ denotes a characteristic length; $U$ denotes the body's speed of translation. Dimensional deduction of this parameter does not limit it to the acceleration of gravity, and the resistance coefficient is affected by the general acceleration to which the air is subjected. Evaluation of the acceleration of the air flowing about spheres puts this parameter in the form $L/R$, where the characteristic length $L$ is interpreted as the mean free molecular path. Large and small spheres were found to have widely different values of the pressure coefficient $\Delta p/q$ for the same Reynolds number or Mach number. Here $\Delta p$ denotes the difference in pressure between front stagnation point and the rear portion of the sphere, and $q$ denotes the dynamic pressure. The plot of $\Delta p/q$ against the parameter $L/R$ removes this confusion. The low values of $\Delta p/q$ are found to be associated with $L/R$ below a certain critical value, and high values of $\Delta p/q$ with $L/R$ above the critical value, which apparently indicates the condition under which the flow separation takes place. Attention is called to the effect of air pressure on the separation as shown by the parameter $L/R$ and its possible bearing on the drag in high altitude flying.

533.6.011.3 716

**Adiabatic air flow.** SAKSENA, G. B. *Aircr. Engng*, **17**, 317–23 (*Nov.*, 1945).—The flow of air under adiabatic conditions through a duct is examined theoretically and it is shown that in cases where the velocity is high the error introduced by assuming the air to be incompressible is considerable. The results are presented in the form of tables, graphs and nomograms which can be readily applied to adiabatic air flow problems. M.-V.

## ACOUSTICS . VIBRATIONS 534

534.113 = 393 717

**Iterative determination of mechanical vibration frequencies.** KOCH, J. J. *Tijdschr. Ned. Radio genoot.*, **11**, 97–108 (*Nov.*, 1945). *In Dutch.*—A simply supported straight rod is considered, with a finite number ($n$) of point masses $m_i$ ($i = 1 \ldots n$), the rod itself being weightless. Hooke's law and Maxwell's reciprocity relation are assumed, and in the absence of damping, the oscillations of the mass points are supposed to be co-phasal. The $n$ oscillation equations are established and it is shown that the equation expressing the vanishing of their determinant has positive real roots, giving $n$ values of $\omega_k^2 (k = 1 \ldots n)$ where $\omega$ is the angular frequency, leading to determination of the amplitudes $\eta_{ik}$ when one of them is known. The solutions are orthogonal,

$$\sum_{i=1}^{n} m_i \eta_{ki} \eta_{li} = 0 \; (k \neq l).$$

To determine the lowest eigenvalue $\omega_1$, arbitrary deflections $y_{1i}$ ($i = 1 \ldots n$) are assumed and, neglecting higher powers of $\omega_1/\omega_k$ ($k = 2 \ldots n$), an approximate value of $\omega_1^2$ is found. Iteration leads to closer approximation, and higher values $\omega_2^2$, $\omega_3^2$, may likewise be determined. The method is applicable to more complex systems. J. A. W.

534.12/.13 71

**Flexural vibration of unrestrained cylinders and disks.** PICKETT, G. *J. Appl. Phys.*, **16**, 820–31 (*Dec.*, 1945).—Solutions are given for the free flexural vibration of a cylinder vibrating as a rod would vibrate and for the free flexural vibration of a disc vibrating as a circular plate would vibrate. The solutions are based upon the mathematical theory of elasticity. Curves are given showing the correction factors, which, when applied to the elementary solutions, will give results in agreement with those obtained by means of the more rigorous solutions given here.

534.121.1 71

**The fundamental frequency of vibration of rectangular wood and plywood plates.** HEARMON, R. F. S. *Proc. Phys. Soc., Lond.*, **58**, 78–92 (*Jan.*, 1946).—Equations are derived expressing the frequency of vibration of rectangular wood and plywood plates in terms of elastic constants, dimensions and density. For supported edges, the solution is exact and gives the complete series of overtones. For clamped edges the fundamental frequency is estimated by the

approximate Rayleigh method, but evidence is presented which indicates that the errors introduced by the use of the Rayleigh method are, in fact, negligible. A method of measuring the frequencies is described; comparison of calculated with observed frequencies shows that the former are on the average about 23% high for clamped edges and about the same amount low for supported edges. This discrepancy is attributed to lack of correspondence between the experimental edge conditions and those assumed in the theoretical treatment. Finally, an empirical method, based on the rough proportionality between elastic constants and density of wood, is suggested and justified for obtaining approximate estimates of the fundamental frequencies in terms of plate dimensions only.

534.121.1 : 517.947.44 *see Abstr.* 657

534.121.1 = 3 720

**Natural frequencies of thin rectangular crystal plates.** MÄHLY, H. *Helv. Phys. Acta*, **18** (*No.* 4) 248–51 (1945). *In German.*—Formulae have been given by Bechmann, Ekstein and others for calculating the natural frequencies of crystal plates. The present paper is concerned only with length oscillations of square plates of anisotropic crystals. For the more rapid length oscillations, in which expansion or contraction occurs simultaneously in the two directions parallel to the edges, it is shown that Bechmann's and Ekstein's formulae give values of the frequency which are too high. A better result has been obtained by representing the boundary conditions by means of a 10-term polynomial. This enables a lower limit for the frequency to be calculated and also a closer upper limit. The frequency errors for a value of Poisson's ratio of 0·3 given by the new formulae do not exceed 0·3%. Ekstein's approximation gives an error of at least 1·4% and Bechmann's formula 3·7%. A. W.

534.121.1 : 621.396.611.21 = 3 721

**Artificial crystal with a zero temperature coefficient of resonance frequency at room temperature.** BANTLE, W. *Helv. Phys. Acta*, **18** (*No.* 4) 245–7 (1945). *In German.*—Experiments have shown that a $KH_2PO_4$ crystal in which $H_2$ is replaced by $D_2$ ($KD_2PO_4$) has a null temperature coefficient of frequency at +20°C. A square plate 8·65 × 8·65 × 0·775 mm with edges parallel to the *a* axes and vaporized gold electrodes was found to have a maximum frequency of 116 kc/s at +20°C. This temperature can be lowered by use of a series capacitor. With the above plate the temperature lowering was 7°C with a capacitance of 200 *p*F and 13°C with 100 *p*F. Since the null temperature coefficient is for a transverse oscillation, the crystal can be supported at the centre, the supports serving also as leads to the electrodes. A. W.

534.152 : 534.61 722

**A method for obtaining small mechanical vibrations of known amplitude.** SMITH, D. H. *Proc. Phys. Soc., Lond.*, **57**, 534–42 (*Nov.*, 1945).—The theory of a method for measuring small amplitudes of vibration by means of thin-film optical interference fringes, due originally to Thomas and Warren [Abstr. 2112 (1928)], is developed. Experiments on a specially made moving coil unit are described which confirm the theory. The possibility of using the method for producing a standard source of sound is discussed.

534.22 723

**Ultrasonic dispersion and absorption in hydrogen.** STEWART, E. S., STEWART, J. L., AND HUBBARD, J. C. *Phys. Rev.*, **68**, 231 (*Nov.* 1 *and* 15, 1945).

534.223.2 724

**Shock wave pressures in water produced by impact of small spheres.** MCMILLEN, J. H. *Phys. Rev.*, **68**, 198–209 (*Nov.* 1 *and* 15, 1945).—Microsecond spark shadowgrams were made showing shock waves in water. The waves were produced by spheres $^1/_8$ in to $^1/_4$ in. in diameter when they struck a water surface with velocities between 2 000 and 4 800 ft/sec. Pressures in the wave were calculated from measurements of the absence-of-light band. The pressure was found to be greatest at a point directly ahead of the sphere and to fall off to normal pressures near the surface. The waves of large pressures were observed to travel faster than a sound wave and to have velocities in accordance with the measured pressure. Because of the varying strength over the wave front, the waves have the shape of a semi-ellipse. When the entrance velocity $V$ and projection area of the sphere were varied it was found that the pressure varied as $V^{2\cdot17}$. It also increased linearly with the projection area of the sphere. The pressures were shown to be in fair agreement with those calculated from the compression of the water at the sphere's entrance; in the calculation an arbitrary loss of water in the splash was assumed.

534.24/.25 = 4 725

**Reflection and refraction of acoustic waves at the boundary of two liquids at rest or in a relative transference motion.** ESCLANGON, E. *C.R. Acad. Sci., Paris*, **215**, 45–8 (*July* 15, 1942). *In French.*—A mathematical study is made of the special characteristics at the boundary of two liquids capable of a relative transference motion, as distinct from the case of a rigid boundary undisturbed by the acoustic waves. E. R. A.

534.321.9 726

**Ultrasonic lenses and transmission plates.** ERNST, P. J. *J. Sci. Instrum.*, **22**, 238–43 (*Dec.*, 1945).—The author claims that solid lenses give the best results for ultrasonic work; as aluminium and glass have almost the same acoustic resistivity as quartz, lenses in these materials may be joined directly to the generating crystal. When there is a large difference in acoustic resistivity between two media, the loss due to back-reflection at the discontinuity may be reduced by transmission plates, i.e. parallel-sided sheets of suitably chosen intermediate resistivities. A photograph is included, showing the focusing effect of a plastic lens. N. C.

534.39 : 535 : 541.18 = 4 727

**Optical properties of a colloidal solution of tungsten trioxide traversed by ultrasonic waves.** BÖMMEL, H., AND NIKITINE, S. *Helv. Phys. Acta*, **18** (*No.* 4) 234–8 (1945). *In French.*

534.415 : 621.317.785.089.6 = 4 728

**Stroboscopic method for checking and regulating electric supply meters on consumers premises.** MAILLAT, G. *Rev. Gén. Élect.*, **51**, 237–42 (*April*, 1942). *In French.*—[Abstr. 565 B (1946)].

534.442 729

**Visible patterns of sound.** POTTER, R. K. *Science*, **102**, 463–70 (*Nov.* 9, 1945).—This paper describes an automatic converter of sound into visible patterns (the "sound spectrograph") for use mainly as an aid to the deaf. The analysed sound is recorded on magnetic tape and played repeatedly into a filter, the passband of which is scanned periodically across the whole frequency spectrum. The output operates a stylus moving over electro-sensitized paper. All three—tape, scan, paper—are ganged, so that a three-dimensional picture (frequency-time-intensity) is obtained. Time is recorded along the horizontal, frequency along the vertical axis, amplitude information is given by various shades of grey. Resonances and beats between various harmonics are observable. Different speakers (male or female) will produce for the same sentence the same basic pattern, so that it becomes possible, after training, to recognize particular words. A development of a two-dimensional sound-vision translator led to poor results, as it imposed unusual strain on memory, the analogy being: Three-dimensional pattern corresponds to printed words moving slowly from right to left on a tape, two-dimensional pattern corresponds to viewing a single letter at a time, appearing through a narrow slit. Two large-scale experiments were conducted: Firstly, training pupils (normal and deaf) to read the patterns; quicker results were obtained than with lip-reading methods. Secondly, discrimination tests, to find out the resolution necessary to avoid ambiguity with similarly sounding syllables. A. L.

534.6 730

**Measurement of supersonic absorption in water by the balance method with mechanical integration.** HSU, E. T. Y. *J. Acoust. Soc. Amer.*, **17**, 127–31 (*Oct.*, 1945).—Measurements were made over a range 10–58 Mc/s. The acoustic radiation pressure on a square plate various distances from the source was measured by weighing, and by moving the plate laterally, the total pressure out to the edges of the beam could be obtained by integration. It is claimed that this removes inaccuracies of measurement due to beam divergency. Detector plate and walls of the tank were coated with fine sand to prevent regular reflection and standing waves. The results are in good agreement with Fox and Rock [Abstr. 1886 (1941)], the absorption coeff. varying directly as $(\text{freq.})^2$ with no sign of an absorption band. $(2\alpha/\nu^2)_{av} = 45{\cdot}4 \times 10^{-17}$ which is $2\frac{1}{2} \times$ the Stokes theory value; this disagreement is discussed.

534.61 : 534.152 *see Abstr.* 722

534.647 : 550.341 : 621.317.39 = 82 731

**Short description of an electrical clinometer.** JOURAVLEV, I. I. *Izv. Uzbekistan Branch Acad. Sci., USSR*, **10**, 35–8 (1940). *In Russian.*—The instrument consists of a Zoellner horizontal pendulum with electrical means for recording displacements. The pendulum arm carries two Pt wires, whose ends dip into mercury filled tubes. The wires form two arms of a resistance bridge, which is unbalanced by a movement of the pendulum. Using a pendulum of amplification factor 300, an overall sensitivity of 1 : 48 880 is obtained, and it is claimed that this could be increased 10 times with a better galvanometer. An improved version is discussed, in which Hg contacts are eliminated by replacing the Pt wires by Bi wires moving in and out of a magnetic field. This would have a sensitivity of 1 : 500 000. A. L.

534.773 : 612.85 732

**Clinical phenomena in conductive media: The individual earpiece.** SCHIER, M. B. A. *J. Acoust. Soc. Amer.*, **16**, 77–82 (*July*, 1945).—The design of plastic earpieces for insertion into the auditory meatus is discussed with respect to the production of mechanical and acoustical aids for deafness. B. J. L.

## OPTICS . RADIATION . SPECTRA 535

535 : 541.18 : 534.39 = 4 *see Abstr.* 727

535.11 733

**Interaction with the absorber as the mechanism of radiation.** WHEELER, J. A., AND FEYNMAN, R. P. *Rev. Mod. Phys.*, **17**, 157–81 (*April–July*, 1945).—Action at a distance is unable fully to account for the mechanism of radiation. A quantitative formulation of the idea that the absorber may be an essential element of the act of emission is given here on the basis of the following postulates: (1) An accelerated charge in otherwise charge-free space does not radiate energy. (2) The fields which act on a given particle arise only from other particles. (3) These fields are represented by $^1/_2$ the retarded plus $^1/_2$ the advanced Lienard–Wiechert solutions of Maxwell's equations. In a system containing particles sufficient in number ultimately to absorb all radiation, the absorber reacts upon an accelerated charge with a field, the advanced part of which, evaluated in the neighbourhood of the source on the basis of these postulates, is found to have the following properties: (1) It is independent of the properties of the absorbing medium. (2) It is completely determined by the motion of the source. (3) It exerts on the source a force which is finite, is simultaneous with the moment of acceleration, and is just sufficient in magnitude and direction to take away from the source the energy which the act of radiation imparts to the surrounding particles. (4) It is equal in magnitude to $^1/_2$ the retarded field minus $^1/_2$ the advanced field of the accelerated charge itself, just the field postulated by Dirac as the source of the force of radiative reaction. (5) This field compensates the $^1/_2$-advanced field of the source and combines with its $^1/_2$-retarded field to produce the full retarded disturbance which is required by experience. Radiation is concluded to be a phenomenon as much of statistical mechanics as of pure electrodynamics. A complete correspondence is established between action at a distance and the usual formulation of field theory in the case of a completely absorbing system. In such a system the phenomenon of pre-acceleration appears as the sole evidence of the advanced effects of the theory of action at a distance. Other advanced effects appear in the case of an incompletely absorbing system and are also discussed.

535.14 : 530.145 *see Abstr.* 685

535.23.08 : 535.33–15 : 621.317.794 734

**Alternating-current bolometer for infra-red spectroscopy.** Schlesman, C. H., and Brockman, F. G. *J. Opt. Soc. Amer.*, **35**, 755–60 (*Dec.*, 1945).—The bridge, amplifier-recorder, and bridge power supply systems are described, and certain improvements are pointed out. The useful sensitivity is limited now by fluctuations originating in the power supply to the bolometer bridge. A temperature rise of $11 \times 10^{-6}$ deg. C in the bolometer arm is detectable.

535.231 : 621.396.821 : 523.72 *see Abstr.* 666

535.233 : 535.642.2 *see Abstr.* 763

535.243 735

**Errata: Uses of retardation plates in spectrophotometry. III. Measurement of dichroic samples.** Buc, G. L., and Stearns, E. I. *J. Opt. Soc. Amer.*, **35**, 724 (*Nov.*, 1945).—[See Abstr. 2864 (1945)].

535.243 : 541.138 : 541.486 = 397 736

**The complexity of iron chlorides.** Olerup, H. *Univ. Lund* (*Thesis Phys. Inst.*) 93 *pp.* (1944). *In Swedish.*—The complexity of $FeCl_3$ and $FeCl_2$ was determined from spectrophotometric (Hilger quartz spectrograph with Spekker photometer) and electrometric measurements (oxidation-reduction potential in $Fe^{3+}$ and $Fe^{2+}$ salt solutions). The apparatus is described in detail, a method of determining the zero point of the Spekker is indicated and sources of error are discussed. The calculation of equilibrium constants of a composite system from absorption measurements is described. The molar extinction for $Fe(ClO_4)_3$ and $Fe(ClO_4)_3 + HCl$ in the ultraviolet was determined. It is concluded that $Fe(ClO_4)_3$ is completely dissociated. The complexity of $FeCl_3$ is determined photoelectrically, the complexity of $FeCl_2$ is calculated from the electrometric measurements by the aid of the formation function of $FeCl_3$. J. A. W.

535.243 : 545.828 737

**A method of eliminating calculations in routine quantitative spectrographic analysis by means of a curved galvanometer scale.** Henderson-Hamilton, J. C., and Lourie, A. *J. Soc. Chem. Ind., Lond.*, 64, 309–12 (*Nov.*, 1945).—Hitherto it has been the general practice to use a plain centimetre scale in conjunction with a reflecting galvanometer to obtain microphotometer readings. The readings thus obtained are related to the relative intensities of lines in the spectrum and hence to concentrations of the constituents of the sample by some form of mechanical calculator which generally involves the drawing of a density curve. These intermediate steps can be avoided in routine work by the use of a curved scale which accurately represents the density curve for all types of photographic plate examined.

535.247.4 738

**Cosine response of photocells and the photometry of linear light sources.** Morton, C. A. *Light and Ltg*, **38**, 157–60 (*Nov.*, 1945).—If the illumination on a horizontal plane due to a fluorescent lamp is being measured at various positions there are two possible errors, viz. (1) the so-called cosine error of the photocell, if the latter is horizontal and at some distance from the point below the lamp, and (2) the fact that the ratio of the illumination on the horizontal to that of a surface facing squarely the centre of the lamp does not exactly equal the cosine of the angle between these two positions, owing to the length of the source. The author gives a simple method for deciding at what distance from the lamp to change over from the horizontal to the tilted position so that the error may be as small as possible. J. W. T. W.

535.247.4 : 537.531 739

**The design of a microdensitometer.** Brentano, J. C. M. *Rev. Sci. Instrum.*, **16**, 309–15 (*Nov.*, 1945).—Examines design and operational procedure for microdensitometers from the viewpoint of certain types of measurements, e.g. measurement of line distances on X-ray diffraction patterns and evaluation of the intensity distribution of X-ray reflections. The reasons for the demands of this type of work exceeding those for optical spectra are discussed. The various techniques are examined. Finally a full description is given of an instrument designed to meet some of the requirements discussed. A. H.

535.31 740

**The optical sine-condition.** Hopkins, H. H. *Proc. Phys. Soc., Lond.*, **58**, 92–9 (*Jan.*, 1946).—The sine-condition is formulated on the basis of optical path differences, leading to an expression which is valid in the presence of spherical aberration. It is shown to contain results obtained previously by means of a "ray-intersection" analysis. The "next terms" are estimated and serve as an approximate measure of the error involved; or, alternatively, as an indication of the size of field over which the sine-condition is a valid measure of off-axis aberration.

535.31 741

**Herschel's condition.** Hopkins, H. H. *Proc. Phys. Soc., Lond.*, **58**, 100–5 (*Jan.*, 1946).—The change in spherical aberration introduced by a change in object distance is discussed. Herschel's condition is shown to be valid for originally corrected conjugates. It follows as a special case of the general formulae derived.

535.317 : 771.351.4 742

**Theoretical investigation on telephoto lenses.** Smith, T. *Proc. Phys. Soc., Lond.*, **57**, 543–58 (*Nov.*, 1945).—The theory of thin lenses is employed to investigate possible forms of telephoto lenses consisting of two widely separated thin components. From a consideration of the shapes of the unit surfaces it is shown that permissible forms have a limited range on either side of those in which both components are aplanatically corrected; on the one side the lenses tend to present their more convex aspects to one another, on the other side their more concave aspects. On taking other conditions into account it is found that heavy figuring is required except in two cases. In one of these the components are nearly aplanatically corrected, and in the other they are strongly concave towards one another. The former construction has the advantage in offering less strongly curved surfaces. It is shown that a design of this class, consisting of two ordinary cemented doublets each made from the same kinds of glass, has stable characteristics. The formulae used in the investigation are given.

535.317.6 743

**Variational formulae in optics.** SMITH, T. *Proc. Phys. Soc., Lond.*, **57**, 558–64 (*Nov.*, 1945).—Formulae for calculating the effect in a complete optical instrument of small changes in the powers and separations of its component parts are collected together. The coefficients in these formulae need not be specially calculated, for they are already known if rays have been traced through the original system algebraically.

535.317.9 744

**On decentred aspheric plates.** LINFOOT, E. H. *Proc. Phys. Soc., Lond.*, **58**, 65–77 (*Jan.*, 1946).—Errors of centring may occur during the aspheric grinding of the plates and also in the lining up of plate-mirror systems. It is first shown that if a grinding technique is used which builds up the asphericity at a proportionately equal rate all over the surface, the result of a large number of small centring errors at different stages of the grinding is very nearly equivalent to a simple decentring of the asphericity on the surface, combined with a small amount of primary astigmatism. Next, general formulae are obtained for the effects on the Seidel errors of a centred system of decentring and tilting its components, and it is shown that in the case of a plate-mirror system the formulae can be used to estimate the practical tolerances for disturbances of this kind. Lastly, the general formulae are applied to discuss the lining up of a two-sphere one-plate Schmidt–Cassegrain camera.

535.317.9 : 535.822.8 745

**Flat-fielded singlet aplanats.** BURCH, C. R. *Proc. Phys. Soc., Lond.*, **57**, 567–76 (*Nov.*, 1945).—The design of flat-fielded aspheric aplanatic singlets is discussed by means of the "plate diagram," and two flat-fielded singlets of $n = 1{\cdot}525$ are designed. Flat-fielded mirror pairs are discussed, and it is shown that a sufficient condition for Seidel field-flatness is that object and image should lie on planes tangent to the mirror surfaces. Some formulae relating to reflecting microscope design are given.

535.324.2 : 532.72 *see Abstr.* 713

535.324.2 : 541.123.31 *see Abstr.* 856

535.33.072–15 746

**A versatile infra-red spectrograph.** OETJEN, R. A. *J. Opt. Soc. Amer.*, **35**, 743–4 (*Dec.*, 1945).—The instrument has sufficient flexibility for a wide variety of investigations. Any one of 2 prisms and 2 gratings, mounted on a table rotated by a large worm wheel, may readily be put into the path of the collimated radiation. A foreprism spectrometer is built into the instrument in such a way that it may be by-passed. The spectrograph case and the source housing are evacuable. Moving parts in the evacuated chamber are controlled electrically from a semi-portable unit outside the spectrograph. The widths of the slits are automatically varied so that the output of the radiation detector thermocouple is approximately the same for all spectral regions if no absorbing material is in the path. The radiation detector is a rapid-response evaporated thermocouple whose output is amplified by a vacuum tube amplifier. A pulsating thermocouple output voltage is obtained by interrupting the radiation at the entrance slit by a rotating shutter. Shutters of metal, mica, and NaCl are used to minimize the effect of scattered radiation. A thyratron-operated calibration flasher is used to put reference lines on the photographically recorded spectra. The housing in which the Nernst glower is mounted is equipped with windows so that it may be divided into compartments to serve also as a vapour cell. This unit carries a mounting designed to locate a liquid cell precisely.

535.33–15 : 621.317.794 : 535.23.08 *see Abstr.* 734

535.337 : 538.615 747

**Structure and Zeeman-effect of doubly ionized thorium, Th III.** DE BRUIN, T. L., AND KLINKENBERG, P. F. A. *Proc. Ned. Akad. Wet.*, **43** (*No. 5*) 582–90 (1940). *In German.*—The Zeeman-effect of Th III has been investigated by an interferometric method, using a quartz Lummer plate crossed with a quartz spectrograph. Fifty energy levels of doubly ionized Th have been detected, and a classified list of Th III lines is given. The structure of the Th III spectrum is compared with that of Ra I, La II and Ce III. It is analogous to Ce III but not to Ra I. The lowest configurations in the Th III spectrum are *fd* and *fs*, whereas in the Ra I spectrum they are $s^2$, *sp* and *sd*. The *g*-values for La II, Ce III and Th III are compared. A. J. M.

535.338.334 748

**On the shape of collision-broadened lines.** VAN VLECK, J. H., AND WEISSKOPF, V. F. *Rev. Mod. Phys.*, **17**, 227–36 (*April–July*, 1945).—Strong and weak collisions are defined and discussed and a simple derivation is given of the Debye formula for the polarization. The Lorentz oscillator theory of line broadening is presented and modified to give agreement with the Debye theory. Some remarks are made on the validity of the formulae obtained. L. S. G.

535.338.4 : 535.343.31 : 539.132 749

**Electronic spectra of polyatomic molecules. Vibrations of the $^1B_{2u}$-state of benzene.** INGOLD, C. K., AND LEEKE, F. M. *Nature, Lond.*, **157**, 46–7 (*Jan.* 12, 1946).

535.338.4 = 3 750

**Band spectrum of tellurium dichloride as a forbidden system.** SPINNLER, W. *Helv. Phys. Acta*, **18** (*No.* 4) 297–316 (1945). *In German.*—The absorption spectrum in the visible of ordinary $TeCl_2$ and of $TeCl_2$ enriched with $Cl^{37}$ has been investigated. The vibrational analysis has been carried out, and the following frequencies have been determined for the symmetrical and deformation vibrations: $\omega_s''$ 391, $\omega_s'$ 314, $x_s''\omega_s''$ 2·5, $x_s'\omega_s'$ 0·5, $\omega_\delta''$ 71, $\omega_\delta'$ 58 $cm^{-1}$. Isotope splitting shows that the $TeCl_2$ molecule is triangular, with the angle at Te 72°. On the basis of the selection rules for triatomic symmetrical molecules, the spectrum is that of a forbidden electron transition. Frequencies of the antisymmetrical vibrations are $\omega_{as}''$ 360, $\omega_{as}'$ 290 $cm^{-1}$. A. J. M.

535.338.42 751

**The analysis of the vibration-rotation band $\omega_3$ for $C^{12}O_2^{16}$ and $C^{13}O_2^{16}$.** NIELSEN, A. H., AND YAO, Y. T. *Phys. Rev.*, **68**, 173–80 (*Sept.* 1 *and* 15, 1945).—[See Abstr. 66 (1946)].

535.341 : 535.43 : 551.463 752

**Optics of distilled and natural water.** HULBURT, E. O. *J. Opt. Soc. Amer.*, **35**, 698–705 (*Nov.*, 1945).—Measurements were made of the attenuation and scattering coefficients of (*a*) distilled water, (*b*) water from Chesapeake Bay and (*c*) water taken 2½ miles from the coast of Florida at a depth of 70 fathoms. The results were related theoretically with measurements of the reflection factor of the surface of the water in these localities, as observed from the air. J. W. T. W.

535.343 753

**The vibrational spectra of esters and ketones.** THOMPSON, H. W., AND TORKINGTON, P. *J. Chem. Soc.*, 640–5 (*Oct.*, 1945).—The vibrational spectra of a number of ketones and esters were measured between 5–20 $\mu$. Correlation of strong bands found in related series suggests assignments of some of the frequencies to vibrations of particular parts of the nuclear frameworks, which may be useful in disentangling the spectra of complex molecules containing these groupings. The results are also useful in suggesting key bands for infra-red analysis of mixtures of these compounds, or for the detection of impurities.

535.343.2–15 : 549.211 754

**Infra-red absorption spectrum of diamond.** KRISHNAN, R. S., AND RAMANATHAN, K. G.; SUTHERLAND, G. B. B. M. *Nature, Lond.*, **157**, 45–6 (*Jan.* 12, 1946). —The first letter claims that the results of Sutherland and Willis [Abstr. 1419 (1945)] are in accord with Raman [Abstr. 1877, 2637 (1944)]. The second letter contests this.

535.343.31 : 539.132 : 535.338.4 *see Abstr.* 749

535.343.4–31 755

**New ultra-violet band-systems of SiS, SiSe and SiTe.** VAGO, E. E., AND BARROW, R. F. *Nature, Lond.*, **157**, 77 (*Jan.* 19, 1946).

535.37 756

**The phosphorescence of various solids.** RANDALL, J. T., AND WILKINS, M. H. F. *Proc. Roy. Soc. A*, **184**, 347–64 (*Nov.* 6, 1945).—The experimental apparatus and technique for measuring the decay law of phosphorescence is described and the results of some measurements are given. Pure uranyl salts decay exponentially and are not photoconductors. The luminescence of these salts is a property of excitation states in the co-ordination group of the uranyl ion, and the transitions are of the forbidden type. The phosphorescence of five solids containing Mn impurity is examined. Cd silicate, Zn mesodisilicate, Cd chlorophosphate, Cd borate and $NH_4$ uranyl phosphate. The first four of these give almost exponential decay curves, independent of phosphorescence intensity. The photoconduction of these solids is also present in the pure state and apparently is not associated with the luminescence process. In the case of Zn orthosilicates with Mn impurity (willemite) and various Zn–Be silicates the decay is approximately exponential at first but subsequently a phosphorescent tail develops. This is explained by introducing the idea of electron traps. L. S. G.

535.37 757

**Phosphorescence and electron traps. I. The study of trap distributions.** RANDALL, J. T., AND WILKINS, M. H. F. *Proc. Roy. Soc. A*, **184**, 366–89 (*Nov.* 6, 1945).—The connection between thermoluminescence, phosphorescence and electron traps in solids is investigated. The glow-curves for a ZnS–Cu phosphor and a SrS–Bi phosphor are determined and a theory of the glow-curve is given. Thermoluminescence and long-period phosphorescence arise from the release of electrons from metastable levels or traps. Methods are developed for finding the depths of electron traps in phosphors. The phosphor is excited at low temperatures until all the traps are filled; it is then warmed at a steady rate and the light emitted while warming is measured as a function of the temperature. The trap distribution in impurity phosphors (e.g. willemite) is generally complex and extends over a wide range. The probability of release of an electron from a trap of depth $E$ at a temperature $T$ is $se^{-E/kT}$ where $s$ is a constant, in the neighbourhood of $10^{8\pm1}$ sec$^{-1}$ for alkaline earth and Zn sulphides. L. S. G.

535.37 758

**Phosphorescence and electron traps. II. The interpretation of long-period phosphorescence.** RANDALL, J. T., AND WILKINS, M. H. F. *Proc. Roy. Soc. A*, **184**, 390–407 (*Nov.* 6, 1945).—The phosphorescence decay laws are found theoretically for these trap distributions: (1) single trap depth, (2) uniform distribution of traps, (3) quasi-uniform trap distributions, (4) exponential trap distribution. An experimental method is described for measuring long-period phosphorescence decay curves and results are reported relating to Ca and Sr sulphides and Zn sulphide phosphors. For the latter an exponential trap distribution is found and this yields a simple inverse power law for the theoretical decay curve. Measurements of decay, using an electron multiplier, confirm the theory. The work provides the first satisfactory and thorough explanation of long period decays. Modification due to re-trapping of electrons is discussed. L. S. G.

535.37 759

**Short period phosphorescence and electron traps.** GARLICK, G. F. J., AND WILKINS, M. H. F. *Proc. Roy. Soc. A*, **184**, 408–33 (*Nov.* 6, 1945).—The decay is measured during the first few milliseconds of the process. Exponential decay occurs when luminescence is due to an optical transition of the forbidden type. This is shown by a study of the ruby. The effect of temperature on exponential decay is studied. A temperature dependent decay is sometimes superimposed on an exponential decay. This is studied by experiment in the case of ZnS–Mn. Hyperbolic decay, characteristic of ZnS–Cu and ZnS–Ag is due primarily to the time electrons spend in traps; thus the bimolecular theory is largely rejected. The change of shape of the decay curve with temperature is explained. L. S. G.

535.393 760

**Values of the optical constants for beryllium, magnesium and zinc.** BOCK, R. O. *Phys. Rev.*, **68**, 210–13 (*Nov.* 1 *and* 15, 1945).—Reflectivities of evaporated

metal films have been observed under varying conditions, allowing the computation of conductivities and permittivity by a previously described method [Abstr. 2176 (1943)]. A reflectometer employing both a photo-cell and a thermopile permitted measurements in the visible and near infra-red regions. Curves are included showing the values of the constants for Be, Mg, Zn and Cu. Comparisons are made with other published results.

535.411 : 778.3 761

**An apparatus for photographing interference phenomena.** SAUNDERS, J. B. *J. Res. Nat. Bur. Stand., Wash.*, **35**, 157–86 (*Sept.*, 1945).—An instrument is described for recording the changes produced in the order of interference fringes over long periods and for recording large changes in the order of interference. It can be made to yield a continuous record of the simultaneous changes in temperature, time, index, strain and density. For example, to record the annealing of an optical glass requires several weeks of continuous recording. The total amount of 35-millimeter film needed by the instrument for such a record (covering, say 3 months) does not necessarily exceed 10 ft. To record the expansion of a material that is being heated from room temperature to 500°C, at a rate of 3°C/min, requires approx. 1 ft of 35 mm film. The fringes are photographed at their natural size, and the fringe shifts can be determined from the photographic record without the use of enlarging or projection equipment.

535.417 : 541.183 *see Abstr.* 871

535.417 : 620.179.6 762

**The measurement of finely finished surfaces by optical interference.** TIMMS, C. *J. Sci. Instrum.*, **22**, 245–6 (*Dec.*, 1945).—[Abstr. 481 B (1946)].

535.42 : 551.593.9 *see Abstr.* 920

535.43 : 551.463 : 535.341 *see Abstr.* 752

535.642.2 : 535.233 763

**Colours of total radiators expressed on the C.I.E. trichromatic system for the temperature range 0–1–660 mireds ($C_2 = 14\,384{\cdot}8$).** HARDING, H. G. W. *Proc. Phys. Soc., Lond.*, **58**, 1–21 (*Jan.*, 1946).—Six-figure tables of the trichromatic coefficients of the colours of Planckian (total or black-body) radiators expressed on the C.I.E. trichromatic system (1931) are given for the temperature range 0–1–660 mireds [micro reciprocal deg., see Abstr. 1866 (1933)]. The colours refer to energy distributions calculated from Planck's formula with a value 14 384·8 micron degrees for the constant $C_2$. Additional tables give the differences in the coefficients of the colours from the tabulated values for a change in the value of $C_2$ from 14 384·8 to 14 320 and from 14 384·8 to 14 350. These additional tables can be used to calculate the colours if other values of $C_2$ are used in Planck's formula. [See Abstr. 2567 (1944), 1974 (1934)].

535.65 = 4 764

**Ideal colorimetric filters. Possibility of realization and use for study of ordinary filters.** BLOTTIAU, F. *Rev. Opt. (Théor. Instrum.)*, **22**, 85–100 (*April–June*, 1943). *In French.*—Discusses what may be considered as the curve of spectral transmission for the ideal filter. A set-up (on the lines of a monochromator) is described suitable for producing light equivalent to that from an ideal filter and details are given of apparatus, using a Lummer–Brodhun cube, for comparing ordinary filters with the ideal filter. A. H.

535.66 : 666.24 : 656.25 765

**Specification of railroad signal colours and glasses.** GIBSON, K. S., HAUPT, G. W., AND KEEGAN, H. J. *J. Opt. Soc. Amer.*, **35**, 772–95 (*Dec.*, 1945).—A continuation of Abstr. 2922 (1939) describing the co-operative work leading to the formulation of the Association of American Railroads Signal Section, specifications for signal colours and glasses. The previous paper defined the luminous transmission scale used by the signal engineers and glass manufacturers. The present paper describes the glasses selected by these engineers to define the limits of acceptable chromaticities afforded by these glasses when combined with kerosene or electric illuminant. The spectral transmissions of the glasses are given, together with the luminous transmissions and chromaticities for the specified illuminants. The photometric and colorimetric parts of the AAR Signal Section three-part specifications are illustrated, and the reasons given for the choice of tolerances both on the acceptable signal colours and on the glasses certified by the National Bureau of Standards as duplicates of the standard limit glasses. Various other data of interest are given, including the expression of the permissible chromaticities of signal colours in a uniform-chromaticity-scale co-ordinate system.

535.733.5 766

**A modified Helmholtz line-element in brightness-colour space.** STILES, W. S. *Proc. Phys. Soc., Lond.*, **58**, 41–65 (*Jan.*, 1946).—The Helmholtz expression for the relation between the trichromatic co-ordinates $x, y, z$ and $x + \delta x$, $y + \delta y$, $z + \delta z$, of two juxtaposed light patches which can just be discriminated by the eye is

$$\left(\frac{\delta x}{a+x}\right)^2 + \left(\frac{\delta y}{b+y}\right)^2 + \left(\frac{\delta z}{c+z}\right)^2 = \text{const.} = \delta s^2$$

To explain the observed variation of the hue limen through the spectrum it demands double-peak fundamental response curves which are at variance with other evidence. It also leads to a step-by-step visibility curve of wrong shape. The difficulties are removed by introducing different constant factors in the three terms. Such a modification is indicated independently by recent measurements of the liminal brightness increment, from which appropriate values of the factors have been derived. The factor in each term is simply related to the limiting Fechner fraction of the corresponding trichromatic mechanism, i.e. the Fechner fraction $\Delta B/B$ which would be observed at sufficiently high brightnesses $B$ if visual discrimination depended on that mechanism only. The modified expression for $\delta s^2$ is applied to the calculation of hue limens, the step-by-step visibility curve, the Fechner fraction curves, and the general colour limen at different points of the colour triangle. Certain main features of the experimental results are correctly reproduced, but some discrepancies with measurements of general colour limens may indicate that the

modified element ignores some factor which is operative in their experiments.

535.8 : 681.4 = 4 767

**Suggestions for the surfacing of aspherical glasses.** Dévé, C. *Rev. Opt.* (*Théor. Instrum.*), **22**, 129–50 (*July–Sept.*, 1943). *In French.*—A survey article which discusses the methods available for producing surfaces of various types, including aspherical, both the theory and the practice of the various methods being examined. Details of the use of the metal Widia (an alloy of W, C and Co) for optical work are given. Details are also given of an epicycloidal mechanism suitable for certain types of surface. A. H.

535.81 768

**Effect of ultraviolet light on glass containing silver.** Badger, A. E., and Hummel, F. A. *Phys. Rev.*, **68**, 231 (*Nov. 1 and* 15, 1945).

535.822.8 : 535.317.9 *see Abstr.* 745

535.822.98 769

**A new pocket prismatic microscope.** O'Brien, D. J. *New Engl. J. Med.*, **232**, 475 (*April* 26, 1945).—This weighs 1 lb 6 oz and measures 4·5 × 2·5 × 5·25 in. By bending the light through four right-angle prisms, the action of a large microscope is made possible. A focal length of 175 mm allows the use of regular objectives and eyepieces. C. J. G.

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536.244 : 677.1 770

**The thermal conductivity of textiles.** Baxter, S. *Proc. Phys. Soc., Lond.*, **58**, 105–18 (*Jan.*, 1946).—A review is given of measurements of the thermal conductivity of natural clothing fibres and of formulae that have been proposed for the overall thermal conductivity of fibre-air mixtures in terms of their density and fibre conductivity. Measurements of the conductivity of wool felts ranging in density from 0·01 to 1·0 gm/cm$^3$ and of solid keratin (horn) were made, and it is suggested that wool fibres and horn have identical conductivities of $4{\cdot}62 \times 10^{-4}$ c.g.s. units at 0·7% regain and $5{\cdot}32 \times 10^{-4}$ c.g.s. units at 10·7% regain. The data given for wool felts and horn are used to obtain an empirical relation between conductivity and bulk density. Results obtained with cotton fabrics indicate that published values of the thermal conductivity of cotton fibres are too high.

536.413 : 548.73 *see Abstr.* 903

536.422.1 = 3 771

**Speed of evaporation of ice.** Mieschер, E., and Tschudin, K. *Helv. Phys. Acta*, **18** (*No.* 6) 456–7 (1945). *In German.*

536.423.1 772

**Vapor pressures and boiling points of some paraffin, alkylcyclopentane, alkylcyclohexane, and alkylbenzene hydrocarbons.** Willingham, C. B., Taylor, W. J., Pignocco, J. M., and Rossini, F. D. *J. Res. Nat. Bur. Stand., Wash.*, **35**, 219–44 (*Sept.*, 1945).

536.424.1 : 537.226.8 : 548.73 = 3 773

**A transformation of higher order in trihydrogen periodate crystals.** Baertschi, P. *Helv. Phys. Acta*, **18** (*No.* 4) 267–96 (1945). *In German.*—The trihydrogen periodates $Ag_2H_3IO_6$ and $(NH_4)_2H_3IO_6$ were investigated dielectrically on the assumption of their structural similarity with $KH_2PO_4$. Anomalies appeared, viz. that both salts undergo a transformation within a definite temperature interval [$(NH_4)_2H_3IO_6$: 246–255°K, $Ag_2H_3IO_6$ : 210–240°K], which changes a strongly polarizable high temperature form to a low temperature modification with smaller permittivity. The course of this transformation was followed accurately with $(NH_4)_2H_3IO_6$ single crystals whose growth is now described. In the critical temperature region large anomalies of specific heat occur which have been measured. An X-ray examination of $(NH_4)_2H_3IO_6$ gave neither a structural change nor an anomalous lattice extension in the transition zone. The transformations are therefore attributed to hydrogen bonding. The similar dielectric behaviour of $(NH_4)_2H_3IO_6$ and HCl indicates a close relationship with rotation changes in dipole molecule crystals. H. H. HO.

536.424.1 : 548.0 = 3 *see Abstr.* 882

536.46 : 541.11 : 662.61 774

**The present era in combustion.** Townend, D. T. A. *Chem. and Ind.* (*No.* 44) 346–51 (*Nov.* 10, 1945).—[Abstr. 695 B (1946)].

536.468 : 621.315.616 = 3 775

**The determination of the flash-point of organic insulating materials.** Zürcher, M. *Schweiz. Arch. angew. Wiss. Tech.*, **11**, 94–6 (*March*, 1945). *See also Bull. Ass. Suisse Élect.*, **36**, 28–33 (*Jan.* 24, 1945). *In German.*—The flash-point or decomposition temperature is defined as that temperature at which the pulverized material begins to evolve inflammable gases. The substance under test is confined in a cylindrical cavity bored into a Cu block which is heated to a prearranged temperature before inserting the material. A nozzle is fixed at the entrance to the cavity and the inflammability of the gases evolved is tested by means of a small flame 3–5 mm wide. The block temperature is measured with an Hg thermometer inserted into a slot drilled into the block.

536.48 776

**Planck's constant and low temperature transfer.** London, F. *Rev. Mod. Phys.*, **17**, 310–20 (*April–July*, 1945).—A contribution to the quantum theory of superconductivity. The analogy between the surface flow of liquid He II and the electric surface currents in a superconductor [*Nature, Lond.*, **150**, 604 (1942)] is examined in detail. It is given in the form of an inequality in which a quantity of the order of Planck's constant appears as a kind of limiting transfer velocity and expresses a connection between the critical rate of transfer and the number of superconducting particles. It is shown that this inequality has a close relationship to the commutation rules of quantum hydrodynamics. L. S. G.

536.531.087.6 777

**An automatic recorder for resistance thermometry.** Stull, D. R. *Rev. Sci. Instrum.*, **16**, 318–21 (*Nov.*, 1945).—A completely automatic recording Wheatstone bridge is designed especially for use in resistance

thermometry. It is built into a standard commercial recorder, contains decade coils operated by a Geneva gear mechanism, and increases the original range of the machine 100-fold. A continuous record of resistance *v.* time is made covering a range of 0–100 Ω that may be easily read to 0·001 Ω ± 0·001 Ω. Used in connection with a standard 25 Ω Pt resistance thermometer a temperature range of −190° to 550°C can be covered with a precision of 0·01°C ± 0·01°.

536.58 : 621.316.74 : 621.318.5 778

**An improved thermal control circuit.** IVES, R. L. *Rev. Sci. Instrum.*, **16**, 294–6 (*Oct.*, 1945).—Conventional thermal control circuits, in which the heater current passes through the thermostat contacts directly, or in which a simple relay is controlled by the thermostat contacts, commonly suffer from contact troubles, and produce large amounts of radio interference, which is difficult to suppress. Modification of a standard latching relay by the addition of a contact assembly actuated by the latching armature, and connecting it in a circuit so arranged that current flows only when the thermostat changes from one position to the other, led to a satisfactory solution to the problem.

536.58 : 629.135 779

**Automatic temperature control for aircraft.** GUND, R. A. *Trans. Amer. Inst. Elect. Engrs*, **64**, 730–4 (*Oct.*, 1945).—[Abstr. 693 B (1946)].

536.581 780

**Analysis of operation of a thermostat with contact thermo-regulator.** JELONEK, Z. *Proc. Camb. Phil. Soc.*, **42**, 62–72 (*Jan.*, 1946).—The thermostat considered is similar in principle to that of Turner [Abstr. 284 (1937)]. A theoretical analysis is made of the case where the heater current starts and stops suddenly in the form of rectangular pulses, and the method makes use of the analogy with electrical phenomena in lines with uniformly distributed capacity and resistance. The period of regulation is calculated, and also the dependence of the "internal" temperature upon the ambient temperature. The effect of "backlash" of the thermo-regulator on these quantities is found and the results are presented in graphical form. Some remarks are made on the application of the results obtained to practical thermostats. L. S. G.

536.582 781

**A metal thermoregulator.** STOKES, R. H. *N.Z. J. Sci. Tech. B*, **27**, 75–6 (*July*, 1945).—Because of the low thermal conductivity of glass there is a considerable response-lag in toluene–Hg regulators using a glass container. This instrument uses a 12 ft length of Cu tubing $^5/_{16}$ in. ext. dia. and $^1/_{32}$ in. wall, wound in a helix $3^1/_2$ in. dia. and 12 in. high. The lower end is closed by soldering and the upper end attached to a bent glass tube which contains the Hg–toluene junction. In use the regulator is immersed so as just to cover the horizontal glass tubes; thus only the very small Hg volume in the capillaries above this level is exposed to the uncontrollable variations of room temperature. Such regulators function well at 25°C controlling the temperature to ±0·002° or less. C. J. G.

536.631 : 539.215 782

**The exact measurement of the specific heat of metals at high temperatures. XXXI. The mean specific heat of cobalt in connection with the granular size of its crystalline structure.** JAEGER, F. M., AND ZUITHOFF, A. J. *Proc. Ned. Akad. Wet.*, **43** (*No.* 7) 815–19 (1940).—Electrolytically-deposited fine-grained Co was found to have a mean heat capacity 0·6–2% lower than a purer, coarse-grained sample. After heating to 1 181°c the grains of the fine-grained sample had become much coarser, and the difference in heat capacities over most of the range 600°–1 300°c was not apparent, though still perceptible in the neighbourhood of the transition at 1 125°C. A. J. C. W.

536.632 : 532.122 *see Abstr.* 701

536.7 : 532.5 *see Abstr.* 703

536.8 : 621.56/.57 783

**On a novel form of refrigerator.** HAYES, W. D. *J. Appl. Phys.*, **16**, 642–3 (*Oct.*, 1945).—[Abstr. 2245 B (1945)].

## ELECTRICITY . MAGNETISM . X-RAYS CHARGED PARTICLES 537/538

537.122 : 530.145 *see Abstr.* 686

537.122 : 530.145 = 4 *see Abstr.* 687

537.122 : 538.691 : 538.3 784

**Radiating electron in a magnetic field.** ELIEZER, C. J. *Proc. Camb. Phil. Soc.*, **42**, 40–4 (*Jan.*, 1946).—The equations of motion, in Dirac's classical theory of radiating electrons [Abstr. 3660 (1938)], are solved in the case of an electron moving in a uniform magnetic field. When radiation damping is taken into account, and the motion is restricted to lie in a plane, the physical motion is such that the electron spirals inwards with steadily decreasing velocity, ultimately coming to rest; the non-physical motion is such that the electron spirals outwards with steadily increasing velocity and ultimately escapes to infinity. The non-relativistic equations are solved exactly and a complete solution is obtained. The relativistic equations are solved approximately as a series in ascending powers of the field strength. In the physical motion the velocity begins to decrease and after some time the motion is correctly given by the non-relativistic solution. [For related work see Abstr. 239 (1944)]. L. S. G.

537.123 785

**Production and annihilation of negative protons.** MCCONNELL, J. *Proc. Roy. Irish Acad.*, **50**, 189–221 (*July*, 1945).—The existence of the negative proton is necessary from the theoretical point of view; the fact that it has not been observed is not surprising for it is shown that the rate of production is very small. A study is made of the production of nucleon pairs by the collision of charged pseudo-scalar cosmic ray mesons with nuclear particles in the atmosphere. The pair production is not a large effect since the Heitler–Peng theory of radiation damping, which it is necessary to use, introduces a number of selection rules, and it is found that pair production is a "forbidden" process. A calculation is made, by the approximate

nethod of Weizsäcker and Williams, of the proba-bility of pair production of nucleons by two oppositely charged mesons. The process does not take place if the energy of the incoming meson is less than $4 \times 10^9$ eV. The cross-section starts from zero, reaches a maximum value of $7 \times 10^{-29}$ cm² for a meson of energy about $8 \times 10^9$ eV and falls off slowly to zero. Anti-nucleons, on being produced, are not immediately annihilated. The probability that a high energy proton will be annihilated into mesons on passing through lead is less than 20%. The negative proton, on being brought to rest, is annihilated with emission of light quanta, its mean lifetime being about $10^{-4}$ secs. L. S. G.

537.123 786

**On the scattering of slow mesons.** SINHA, M. S. *Phys. Rev.*, **68**, 153–8 (*Sept.* 1 *and* 15, 1945).—Photographs of mesons of total energy lying between $1{\cdot}55 \times 10^8$ and $2{\cdot}55 \times 10^8$ eV have been obtained by a special arrangement of counters controlling the expansion of the cloud chamber. The scattering of these particles, both multiple and single, has been studied in two thicknesses of lead (2 cm and 4 cm). It is found that though the $\sqrt{t}$ law of Williams holds good for the average angle of scattering, its absolute value is only about 50% of the theoretical value expected from Williams' formula. The Gaussian distribution of the number of particles with angle of scattering is found to be approximately true. A cross-section for the non-Coulombian nuclear scattering has been calculated to be $1{\cdot}84 \times 10^{-26}$ per nucleon for mesons of mean total energy $2 \times 10^8$ eV. This agrees with that calculated by Bhabha and Weinberg and Ma for transversely polarized mesons of this energy, but is about 25× the value found experimentally by Shutt and Code. The too low value of Shutt and others may be attributed to the presence of high energy mesons (for which the nuclear scattering cross-section is very small) in large numbers so as to mask the effect of low energy mesons. One case of a high energy proton being singly scattered has also been obtained.

537.123 787

**On the decay process of positive and negative mesons.** CONVERSI, M., PANCINI, E., AND PICCIONI, O. *Phys. Rev.*, **68**, 232 (*Nov.* 1 *and* 15, 1945).

537.226.8 788

**Theory of dielectric breakdown in amorphous solids.** FRÖHLICH, H. *Rep. Brit. Elect. Allied Industr. Res. Ass., Ref. L/T*153, 7 *pp.* (1945).—It is shown that a temperature $T'$ exists above which the previous theory of dielectric breakdown becomes invalid. $T'$ is characterized by the fact that above it collisions between electrons are of importance in contrast to temperatures $T$ below it. While for $T < T'$ the breakdown field $F$ increases with temperature, it is shown that for $T > T'$ it decreases according to a simple formula ($\log F = a + b/T$, with $a$, $b$ constant). Satisfactory agreement with some experiments was found and further experiments are suggested. This theory of breakdown includes a theory of the conductivity of semi-conductors in strong fields.

537.226.8 : 533.275 : 621.315.612 789

**Influence of humidity on dielectric properties of high-frequency ceramics.** HAUSNER, H. H. *J. Amer. Ceram. Soc.*, **27**, 175–81 (*June*, 1944).—[Abstr. 539 B (1946)].

537.226.8 : 541.66/.67 790

**Dielectric and thermal properties of long-chain substances.** FRÖHLICH, H. *Rep. Brit. Elect. Allied Industr. Res. Ass., Ref. L/T*156, 7 *pp.* (1945).—[See Abstr. 788, 286 B (1946)]. Mainly theoretical. A crystal of 6 long-chain molecules containing a dipolar group, when subject to increasing temperature, undergoes an order-disorder transition, termed a phase transition of the second kind, or $\lambda$-transition. As a result of detailed study it is concluded that (1) a $\lambda$-transition in long-chain substances exists which is connected with an increase of permittivity with temperature below the transition point, and a decrease above it; (2) above the transition point long chains should be no longer plane zig-zags but should be twisted around their axes. Further experiments are suggested to test these conclusions. A. M. T.

537.226.8 : 548.73 : 536.424.1 = 3 *see Abstr.* 773

537.227 : 548.7 : 530.145 *see Abstr.* 688

537.228.1 : 548.0 = 3 *see Abstr.* 883

537.29 : 621.385 : 537.533 *see Abstr.* 795

537.311.33 = 3 791

**Electrical conductivity of silicon carbide.** BRAUN, A., AND BUSCH, G. *Helv. Phys. Acta*, **18** (*No.* 4) 251–2 (1945). *In German.*

537.363 : 541.18 *see Abstr.* 868

537.365 792

**Supersonic vibration potentials and centrifugation potentials.** RUTGERS, A. J. *Nature, Lond.*, **157**, 74–6 (*Jan.* 19, 1946).—Experiments to test the prediction of Debye [Abstr. 1626 (1933)], Rutgers [*Physica*, **5**, 46 (1938)] and Hermans [Abstr. 4751 (1938)] that a potential difference will be established in an assymmetric colloidal electrolyte by supersonic vibrations, or by centrifugation. Colloidal AgI was used. The theoretical potential gradient value was observed in the case of centrifugation at 3 000 revs/min but the observed vibration potential was $^1/_{100}$th of the theoretical (wavelength = 5 mm in water, acoustical pressure, 5 dynes/cm²).

537.531 793

**Absolute intensity of Cu $K\alpha$ radiation from a thick target.** BRAXTON, W. L., BAEZ, A. V., AND KIRKPATRICK, P. *Amer. Phys. Soc.* (*Proc., July*, 1945). *Abstr. in Phys. Rev.*, **68**, 106 (*Aug.* 1 *and* 15, 1945).—Cu $K\alpha$ radiation emerging at a grazing angle of 10° from a thick target was isolated by Ross filters of Co and Ni and received in a large air-filled ion chamber standardized for absolute energy measurements. After allowing for continuous radiation, for absorption in the target, the tube and chamber windows, the intervening air and the filters, it is concluded that the $K\alpha$ energy produced in the target by electron bombardment at 15·5 ekV is $2 \times 10^{-12}$ erg/electron. The efficiency of the production of Cu $K\alpha$ radiation in thick targets at this bombardment energy is about

0·01%. Slightly $<1/2$ the produced radiation emerges from the target face. Corresponding figures for other tube voltages are obtained from relative intensity measurements. The observed intensities were approx. predicted on the basis of earlier measurements of the intensity of $K\alpha$ radiation from thin targets of Ni.

537.531 : 535.247.4 *see Abstr.* 739

537.531 : 574 *see Abstr.* 921

537.531 : 615.849 *see Abstr.* 930

537.531 : 616–073.75 *see Abstr.* 932

537.531 : 621.386 : 615.849 *see Abstr.* 931

537.531.08 : 615.84 *see Abstr.* 928

537.531.9 : 77.019.2 794

**The photographic action of X-rays.** PELC, S. R. *Proc. Phys. Soc., Lond.*, **57**, 523–34 (*Nov.*, 1945).—Theoretical considerations are given, based on the absorption process in photographic emulsions, and found to be in good agreement with experimental results. An equation giving the variation of the photographic action with wavelength is deduced. Consideration is given to the number of grains made developable per absorbed photon; the conclusion is reached that the energy required to make one grain developable is, for a given emulsion, constant for effective wavelength from 47 × 395 X.U.

537.533 : 537.29 : 621.385 795

**Potential topography in electronics.** REIMANN, A. L. *Aust. J. Sci.*, **7**, 44–7 (*Oct.*, 1944).—The diverse phenomena in which electrons move from place to place lend themselves to theoretical treatments which have one essential characteristic in common: a consideration of the "hills," "valleys," etc., of potential over and through which the electrons have to pass, and the way in which this "potential topography" determines their motion. This treatment is outlined for thermionic emission, the diode valve, rectification at the contact between a metal and a semi-conductor, a triode valve, and the c.r.t. C. J. G.

537.533.72 = 4 796

**Electron optics.** GRIVET, P. *Rev. Gén. Élect.*, **51**, 473–84 (*Nov.*, 1942); **54**, 45–54 (*Feb.*, 1945). *In French.*—The principles of electron optics are reviewed. In the first paper the formation of images by electrostatic lenses is dealt with, the methods being those usually adopted in optics. Examples of thick and thin electrostatic lenses are considered. In the second paper, magnetic lenses are dealt with in a similar manner, the formulae governing the calculation of the constants of such lenses being deduced. Experimental methods for determining the distribution of potential and the magnetic field in the two types of lens are described. A. J. M.

537.533.72 797

**Electron beams in strong magnetic fields.** PIERCE, J. R. *Phys. Rev.*, **68**, 629–30 (*Nov.* 1 *and* 15, 1945).—Modifies the conclusions of Brillouin [Abstr. 1857 (1945)] and works out a particular case.

537.533.72 798

**The class of electron lenses which satisfy Newton's image relation.** HUTTER, R. G. E. *J. Appl. Phys.*, **16**, 670–8 (*Nov.*, 1945).—Newton's image relations are satisfied for all electron lenses if object and image are located outside the region of the electromagnetic fields. It is shown that a special class of electron lenses exists for which these relations hold for any object and image position. The results are compared with those obtained by Glaser [*Ann. Phys., Lpz.*, **40**, 367 (1941)].

537.533.72 799

**Rigorous treatment of the electrostatic immersion lens whose axial potential distribution is given by $\varphi(z) = \varphi_0 e^{K \arctan z}$.** HUTTER, R. G. E. *J. Appl. Phys.*, **16**, 678–99 (*Nov.*, 1945).—Investigations have shown that the electrostatic immersion lens, given by the above axial potential distribution, is the simplest electrostatic lens for which Newton's image equations are satisfied throughout the field. The general solution of the paraxial ray differential equation is derived. Based on this solution and the fact that Newton's image equations are satisfied, exact expressions are derived for the focal lengths, the location of the four cardinal points, magnification, the object-image relation, and the spherical and chromatic aberration for any object position. The optimum positions of an object are determined so that the chromatic and spherical aberrations are reduced to a minimum. All quantities are represented graphically. A plot of the equipotential lines in space is given for a special value of the voltage ratio.

537.533.72 : 621.385.832 800

**Complete computation of electron optical systems.** MOTZ, H., AND KLANFER, L. *Proc. Phys. Soc., Lond.*, **58**, 30–41 (*Jan.*, 1946).—[Abstr. 604 B (1946)].

537.533.73 801

**Erratum: Refraction effects in electron diffraction.** STURKEY, L., AND FREVEL, L. K. *Phys. Rev.*, **68**, 209 (*Nov.* 1 *and* 15, 1945).—[See Abstr. 3042 (1945)].

537.533.73 : 621.385.833 802

**High dispersion electron diffraction by primary magnification.** SIMARD, G. L., BURTON, C. J., AND BARNES, R. B. *J. Appl. Phys.*, **16**, 832–6 (*Dec.*, 1945)—High dispersion may be obtained by magnification of a diffraction pattern by a magnetic or electrostatic electron lens. The pattern is formed in the normal manner at the object plane of the lens. Dispersion may be varied continuously by changing the lens current or voltage. The design of diffraction camera of this type is discussed and their value in diffraction problems pointed out. The validity of the method is established by diffraction patterns obtained using a modified electron microscope adapter.

537.534.74 : 539.185 : 539.152.1 *see Abstr.* 826

537.54 : 533.15 : 545.827 *see Abstr.* 878

537.54 : 621.385.822.5 : 538.312 80

**Radiation from a group of electrons moving in circular orbit.** MCMILLAN, E. M. *Phys. Rev.*, **68**, 144–5 (*Sept.* 1 *and* 15, 1945).

537.542 80

**Experiments on counters with grids.** KORFF, S. A.

*Phys. Rev.*, **68**, 53 (*July* 1 *and* 15, 1945).—[See Abstr. 2773 (1940)].

537.542 805

**Effect of the pressure of alcohol vapour on the operation of the fast Geiger-Müller counter.** ROCHESTER, G. D., AND MCCUSKER, C. B. A. *Nature, Lond.*, **156**, 366–7 (*Sept.* 22, 1945).

537.543 : 621.385.822.5 806

**The Synchrotron—a proposed high energy particle accelerator.** MCMILLAN, E. M. *Phys. Rev.*, **68**, 143–4 (*Sept.* 1 *and* 15, 1945).—A particle, in a cyclotron, is considered whose energy is such that its angular velocity matches the frequency of the electric field. It is shown that the orbit of the particle is stationary and stable. The particle may be accelerated by varying the magnetic field or the frequency. While the energy changes, the phase of the motion alters just enough to provide the necessary acceleration. Equations describing the phase and energy variations are given, and an analysis based on these leads to the design of a 300 eMV electron accelerator which avoids the relativistic limit of the cyclotron and is not so expensive as the betatron. L. S. G.

537.543 : 621.396.615.14 = 4 807

**On some new conceptions in the physics and technique of ultra high frequency valve generators.** WARNECKE, R. *Ann. Radiodiffusion*, **4** (*No.* 1) 37 *pp.* (*Jan.*, 1944). *In French.*—[Abstr. 627 B (1946)].

537.581 808

**An explanation of anomalous thermionic emission current constants.** SUN, N. T., AND BAND, W. *Proc. Camb. Phil. Soc.*, **42**, 72–7 (*Jan.*, 1946).—The thermionic current given by equilibrium theory is $= AT^2e^{-\chi/kT}$, where $T$ is the temperature, $\chi$ is the depth of the potential well in which the metal holds the free electrons, and $A$ is a constant. Anomalously large or small values of $A$ may be explained by the usual statistical equilibrium theory provided proper account is taken of the fact that free electrons may be shared by two overlapping energy bands. The theory is developed and this involves the calculation of the statistical parameter $\zeta$, which occurs in the Fermi function, for overlapping bands, when one band is nearly full or both bands are nearly empty. The observed values of $A$ for Ni and for Hf are well explained. L. S. G.

537.591 : 530.145 809

**Theory of cosmic-ray mesons.** HEITLER, W., AND WALSH, P. *Rev. Mod. Phys.*, **17**, 252–62 (*April–July*, 1945).—The theory of the production of mesons given in an earlier paper [Abstr. 2834 (1943)] is revised in accordance with an improvement in the application of the Weizsäcker–Williams method. The energy spectrum and the total number of mesons at sea level, and their variation with height and latitude is worked out and found to be in good agreement with the relevant facts, i.e. within the accuracy of the calculations (which is not greater than a factor ~2). In passing through a nucleus a fast proton produces in general several mesons. The total cross section of a nucleus for production of at least one meson and the relative probabilities for the production of $n$ mesons are worked out. In light elements about 50% of the total cross section is due to production of only 1–3 mesons and 50% to $n = 4 \ldots A$ (atomic weight). The total cross section is in good agreement with the direct experiments in paraffin. The absorption of the primary protons is found to take place according to a cross section slightly larger than the geometrical cross section. The form of the meson theory used is the charge symmetrical mixture of pseudoscalar and vector mesons.

537.591 = 3 810

**On the determination of cosmic-ray coincidences.** KOLHÖRSTER, W. *Z. Phys.*, **120** (*Nos.* 7–10) 539–44 (1943).—Measurements with Al and Fe tube counters in justification of the general tube-counter method [Abstr. 1545 (1941)]. H. G. S.

537.591.3 811

**The decay of the penetrating cosmic rays. IV.** BRUINS, E. M. *Proc. Ned. Akad. Wet.*, **43** (*No.* 6) 699–701 (1940).—Fermi's theory that the different absorption of penetrating cosmic rays in air and in condensed materials is due to the smaller loss of energy of the particles in the condensed material is compared with the alternative theory of decaying electrons. In the case of the Fermi theory the energy distribution is the same in all directions, whereas the theory of decaying electrons requires a changing energy spectrum. A. J. M.

537.591.5 812

**The decrease in the intensity of the cosmic rays in different directions and decay of the mesons. I–II.** CLAY, J. *Proc. Ned. Akad. Wet.*, **43** (*No.* 4) 435–9; (*No.* 6) 664–7 (1940).—The relative coefficient of decrease of intensity of cosmic rays in air and in water, and its variation with direction has been investigated using results obtained in Amsterdam and in Norway. For fairly thick layers the ratio is 1·8 irrespective of direction in the atmosphere. This result means that the permittivity of the condensed material would have to be considerably greater than 2, the value supposed by Fermi. In the second paper, the results of experiments carried out with smaller thicknesses are given. Layers of Pb were used in the vertical direction. The decrease in Pb was compared with that in the atmosphere for small angles. Results are at variance with Fermi's theory, and indicate that the abnormally high decrease in the atmosphere is due to decay of mesons. A. J. M.

537.591.5 813

**Meson intensity in the substratosphere.** BHABHA, H. J., AIYA, S. V. C., HOTEKO, H. E., AND SAXENA, R. C. *Phys. Rev.*, **68**, 147–52 (*Oct.* 1 *and* 15, 1945).—The vertical intensities of mesons penetrating 5·25 and 30 cm of lead have been measured to an altitude of 15 000 ft and of those penetrating 20 cm of lead to an altitude of 32 000 ft (275 millibars pressure) by coincidence counter telescopes sent up in an aeroplane from Bangalore, magnetic latitude, 3·3°N. A comparison of our results with those of Schein, Jesse and Wollan [Abstr. 2111 (1940)] indicates that the latitude effect between 3·3°N and 52°N of the vertical intensity of mesons shows no marked increase even to altitudes corresponding to pressures of 275 millibars. This is in striking contrast with the total intensity,

which shows a very pronounced increase of latitude effect to these heights.

538.082.102 814

**An apparatus for the micro-determination of magnetic susceptibility.** THEORELL, H. *Ark. Kemi Min. Geol.*, **16** A (*No.* 1) *Paper* 1, 8 *pp.* (1943).—For the measurement of the magnetic susceptibilities of iron-poor enzymes such as horse-radish peroxidase it was necessary to devise a more sensitive modification of the Gouy method. Two thin-walled glass tubes about $11 \times 0{\cdot}3$ cm separated by a celluloid partition are fixed end-to-end. One half of this double tube is filled with water, the other with the solution to be investigated. The tube is suspended horizontally with the partition between the poles of a strong electromagnet, and the movement of the tube parallel to its length on application of the field is observed by means of a microscope. The apparatus is calibrated by the use of $FeCl_3$ solutions of known strength. A. J. C. W.

538.114 815

**The ferromagnetism of collective electron assemblies in a metal with overlapping energy bands.** BAND, W. *Phys. Rev.*, **68**, 227 (*Nov.* 1 *and* 15, 1945).

538.114 = 4 816

**Magneto-galvanism rotation of magnetic moment and boundary translations of elementary crystal domains.** PERRIER, A. *Helv. Phys. Acta*, **18** (*No.* 6) 451–5 (1945). *In French.*

538.224 : 541.67 *see Abstr.* 874

538.23 : 548.0 817

**Hysteresis and eddy losses in single crystals of an alloy of iron and silicon.** WILSON, A. J. C. *Proc. Phys. Soc., Lond.*, **58**, 21–9 (*Jan.*, 1946).—The total energy dissipated, in an alternating magnetic field, in single crystals of Fe containing 2·1% Si was measured calorimetrically. Results are given for the field applied in the three crystallographic directions [100], [110], [111]. The total losses are separated into the conventional "hysteresis" and "eddy" components by means of measurements at different frequencies. The "eddy" losses do not appear to be dependent on direction; the "hysteresis" losses for [100] are about one-third of those for the other directions measured. A tentative explanation is suggested.

538.242 818

**New researches on magnetization by rotation and the gyromagnetic ratios of ferromagnetic substances.** BARNETT, S. J. *Proc. Amer. Acad. Arts Sci.*, **75** (*No.* 5) 109–29 (1944).—The ratio of the angular momentum of the magnetic element in ferromagnetics to its magnetic moment, called the gyromagnetic ratio, may be determined by measurements of (1) the magnetization produced by rotation, or of (2) the angular momentum generated by magnetization. Both methods have been used previously by the author [Abstr. 148 (1941), 2611 (1925)]; the second is the more precise. The present paper describes new investigations by the first method, great care being taken to eliminate systematic errors, and accuracy of 1% or better is attained. The results are in good agreement with those previously obtained by the second method. The ratio varies from 0·99 (Heusler alloy) to 1·07 (Co), in units of m/e. The values for Fe and Ni are 1·03 and 1·05 respectively. A. J. C. W.

538.3 819

**Another problem of two electrons.** HOWE, G. W. O. *Wireless Engr*, **23**, 1–2 (*Jan.*, 1945).

538.3 : 538.691 : 537.122 *see Abstr.* 784

538.3.081 : 621.3.011 = 4 820

**Similitude in electricity and radio-electricity.** MÉTRAL, A., AND RAYMOND, F. *Rev. Gén. Élect.*, **49**, 163–73 (*March*, 1941). *In French.*—[Abstr. 502 B (1946)].

538.312 : 621.385.822.5 : 537.54 *see Abstr.* 803

538.56 : 621.396.611.4 = 4 821

**The perturbation method applied to the study of electromagnetic cavity resonators.** KAHAN, T. *C.R. Acad. Sci., Paris*, **221**, 536–8 (*Nov.* 5, 1945). *In French.*—Suppose the wave equation in the plane,

$$\Delta E + k^2 E = 0,$$

has been solved so that the proper functions $E_n$ and the proper values $k_n$ are known for an axially symmetric cavity bounded by a surface $S_0$. If $S_0$ and the volume of the cavity are slightly altered then $E_n$ and $k_n$ will alter. Suppose $k_0$ becomes $k_0 + k_1$. The perturbation method, often used in wave-mechanics, is applied to find an integral expression for $k_1$, and in this way the change in resonant frequency is found. An example is given relating to a $TM_{01}$ wave. L. S. G.

538.566.3 : 621.396.11 822

**On the propagation of radio waves.** RYDBECK, O. E. H. *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 34), 168 *pp.* (1944).—[See Abstr. 172 B (1943)]. A plane ionosphere in which the permittivity $\varepsilon$ is a function of $z$ only, is first considered, and the wave equations are deduced from Maxwell's equations and discussed with reference to transverse and longitudinal transmission, important near magnetic equator and poles. The wave functions for a layer varying parabolically with $z$ are considered and reflection and transmission factors obtained, with due regard to multiple boundary reflections arising from discontinuity of $d\varepsilon/dz$. The series solution is transformed into a contour integral. The transmission round a spherical earth surrounded by an inhomogeneous reflecting shell is next treated and the solution is given in a new and simplified form, admitting physical interpretation. Numerical examples and graphs are given, and the attenuation coefficient is derived. The effect of electron collision upon transmission coefficients and the virtual height is discussed and numerical results are shown. An extremely thin layer is briefly considered, with reference to abnormal E-reflections. J. A. W.

538.615 : 535.337 *see Abstr.* 747

538.652 = 4 82

**Magnetostriction.** BARON, P. *Rev. Gén. Élect.*, **51**, 439–47 (*Oct.*, 1942). *In French.*—A review dealing with the Joule, Villari and Wiedemann effects, and their applications to oscillators, emitters and receivers and the measurement of stresses. The mechanism of magnetostriction is discussed. A. J. M.

538.691 : 538.3 : 537.122 *see Abstr.* 784

## RADIOACTIVITY . ATOMS . MOLECULES 539

539 : 530.145 824

**Application of ordinary space-time concepts in collision problems, and relation of classical theory to Born's approximation.** WILLIAMS, E. J. *Rev. Mod. Phys.*, **17**, 217–26 (*April–July*, 1945).—A general discussion of collision phenomena from two points of view: (1) strong interacting forces, the orbit treatment of classical mechanics being used; (2) weak interacting forces, a quantum mechanical wave treatment (the Born approximation) being used. Scattering, e.g. Coulombian scattering by atomic nuclei, multiple scattering, is reviewed and conditions for the validity of (1) or (2) are examined. The status of the classical treatment of the energy loss in collisions of an $\alpha$- or $\beta$-particle with atoms is briefly considered and an approximate derivation of Bethe's formula for the energy loss is given. L. S. G.

539.132 : 535,343.31 : 535.338.4 *see Abstr.* 749

539.133 : 548.73 *see Abstr.* 904

539.15 : 530.1 825

**Atoms in variable magnetic fields.** BLOCH, F., AND RABI, I. I. *Rev. Mod. Phys.*, **17**, 237–44 (*April–July*, 1945).—Given a quantum-mechanical system of total angular momentum $j$ and with magnetic quantum number $m$ with respect to a magnetic field, the problem is to determine the final state of the system if the field varies in a known manner in magnitude and direction. The results of Majorana [*Nuovo Cim.*, **9**, 43 (1932)], and some further results, are obtained by the application of a familiar vector model where the total spin operator $M$ is expressed as the sum of $2j$ spin operators each representing a system with angular momentum $\frac{1}{2}$. A composite representation of a system with spin $j$ is obtained, and this leads to an elementary derivation of Majorana's results and its limitation in the case of fields which vary in space and time. Majorana's expression for the transition probability appears as a special case of a general formula. L. S. G.

539.152 : 517.948.32 *see Abstr.* 658

539.152.1 : 537.534.74 : 539.185 826

**Calculation of the binding energy of the deuteron and the neutron-proton scattering by a new potential.** WANG, M. H. *Phys. Rev.*, **68**, 163–6 (*Sept.* 1 *and* 15, 1945).—The binding energy of the deuteron and the scattering cross section of the proton by fast neutrons are calculated by using new forms of nuclear potential [see Abstr. 643 (1945)]. Results obtained are found to be in good agreement with experimental values when "zero cut-off" of the potential is employed.

539.152.1 = 3 827

**Taking up of *K*-electron and positron emission of $Cu^{61}$ and $Cu^{64}$.** BRADT, H., GUGELOT, P. C., HUBER, O., MEDICUS, H., PREISWERK, P., AND SCHERRER, P. *Helv. Phys. Acta*, **18** (*No.* 4) 252–5 (1945). *In German.*—The relative value $\Lambda = \lambda_{Cu^{64}}/\lambda_{Cu^{61}}$ of the ratio $\lambda$ of the probability of taking up a *K*-electron to positron emission for $Cu^{64}$ and $Cu^{61}$ has been determined from the intensities of Ni *K*-radiation and the annihilation radiation of the two radioactive Cu isotopes $\Lambda = 5{\cdot}5 \pm 0{\cdot}3$. The $\gamma$-$\gamma$ coincidence rate was the same for the two isotopes $(3{\cdot}4 \pm 0{\cdot}2 \times 10^{-3})$. The positron spectrum of $Cu^{61}$ has been investigated. $E_{max}$ is $1{\cdot}225 \pm 0{\cdot}015$ eMV, in good agreement with the value determined directly. Using this value, $\Lambda = 8{\cdot}1$. A. J. M.

539.155.2 : 578.088.9 828

**Carbon-13.** *Nature, Lond.*, **157**, 71 (*Jan.* 19, 1946).—Carbon substantially enriched in $C^{13}$ isotope is now available commercially for biological and medical research.

539.155.2 = 4 829

**Method of separating isotopes, based on the use of rotating h.f. electric fields.** MARTELLY, J. *C.R. Acad. Sci., Paris*, **215**, 106–8 (*July* 27, 1942). *In French.*—The system proposed is a "velocity filter" designed to select particles of the required velocity in a beam of positive ions. Ions of a given mass are isolated if the beam is homogeneous in energy, or if it is so rendered by selective deviation in a constant electric field. Separation is effected without resort to a magnetic field. The principle is based on the action of two rotating h.f. electrostatic fields on a parallel beam. E. R. A.

539.162 830

**The missing heavy nuclei.** TURNER, L. A. *Rev. Mod. Phys.*, **17**, 292–6 (*April–July*, 1945).—The stability of heavy nuclei is considered. According to the Bohr–Wheeler hypothesis of spontaneous nuclear fission, the mean life of $U^{239}$ would be $10^{22}$ years, but this is very uncertain as the values of the quantities in the exponential term in the calculation of the mean life, exp. $[(2ME_f)^{\frac{1}{2}}\alpha/h]$ are doubtful. The known nuclei have therefore been examined to find which would be the least stable with regard to spontaneous fission, and an estimate is made of the maximum probability of this fission compatible with the known properties of the nucleus. Conclusions concerning other nuclei are then drawn by comparison. The occurrence of spontaneous fission cannot account for the absence of transuranic nuclei, since the probable half-lives for spontaneous fission of many of them are at least as great as those of U (I) and Th. Comparison of properties of nuclei is made with those of $Pu^{239}_{94}$. The half-life of $\alpha$-emitting $Pu^{238}$ is 50 years, suggesting that the corresponding half-lives of other Pu isotopes may be similarly low, so that the absence of certain heavy nuclei may be explained on the basis of the shortness of the $\alpha$-half-lives of the $\beta$-stable nuclei. A. J. M.

539.163.2 831

**Studies in β-spectroscopy.** SIEGBAHN, K. *Ark. Mat. Astr. Fys.*, **30 A** (*Paper* 20) 82 *pp.* (1944).—Details are given of the theory and construction of a $\beta$-spectrograph of the semicircular type, having a pole diameter of 30 cm and providing a homogeneous magnetic field. Photographic and G.-M. tube methods were employed in the registration of spectra. A method was developed for determining the absolute value of $H\rho$ for $\beta$-lines and the values were found for the two principal lines of Th B and the six principal lines of Ra B. The accuracy is about 0·3%. The complete $\beta$-line spectrum of Ra B was investigated

and several new weak lines recorded. The value of $h/m_0$ was found to be $7{\cdot}275 \pm 0{\cdot}020$ which agrees well with previous values. Constructional details of a magnetic lens spectrograph are recorded and its use in $\beta$-spectroscopy is investigated. The spherical aberration was reduced considerably below that of a previous instrument and the lens spectrograph has about 17 times the light intensity of the semicircular spectrograph at the same resolving power. The $\beta$-spectra of $C^{11}$, $Na^{24}$ and $P^{32}$ were studied and the results compared with Fermi's theory of permitted transitions. The agreement is good except at the lower energies. The $\gamma$-lines of Na were investigated. These occur at 2·79 eMV, 1·45 eMV and possibly 1·05 eMV. L. S. G.

539.163.2 = 3 832

**Pair-emission of Th C″.** Bradt, H., Halter, J., Heine, H. G., and Scherrer, P. *Helv. Phys. Acta*, **18** (*No.* 6) 457–8 (1945). *In German.*—Triple coincidence determinations with $\beta$-counters arranged symmetrically with respect to a Th C″ source give the probability for pair emission to be $(1{\cdot}8 \pm 0{\cdot}4) \times 10^{-2}$ pairs per disintegration. This value is increased if a direction correlation of the particles is taken into account. An improved Wilson chamber method was also used. The $\beta$-ray counters were set up in the Wilson chamber, and expansion arranged to take place about 0·01 sec after the discharge of the counters. The traces of the particles were weak and diffuse. The relative frequency agrees well with the results obtained by the triple coincidence method. A. J. M.

539.167.3 833

**Coincidence measurements on $N^{13}$ and $C^{11}$.** Siegbahn, K., and Petersson, S. E. *Ark. Mat. Astr. Fys.*, **32 B** (*No.* 2) *Paper* 5, 3 *pp.* (1945).—An unsuccessful search for coincidences in the disintegration of $N^{13}$, using two counters screened from each other, indicates that there is no coupling between the positron and $\gamma$-radiations, and the $\beta_+$-spectrum corresponds to a simple transition directly to the ground state.

539.167.3 834

**Disintegration schemes of radioactive substances. VIII. $Co^{60}$.** Deutsch, M., Elliott, L. G., and Roberts, A. *Phys. Rev.*, **68**, 193–7 (*Nov.* 1 *and* 15, 1945).—The radiations emitted in the decay of the two isomers of $Co^{60}$ have been studied by means of a magnetic lens spectrometer and coincidence methods. The 5-yr isomer decays by emission of negatrons of maximum energy $0{\cdot}308 \pm 0{\cdot}008$ eMV, followed by two $\gamma$-rays in cascade, of energies $1{\cdot}10 \pm 0{\cdot}03$ eMV and $1{\cdot}30 \pm 0{\cdot}03$ eMV, respectively. At least 90% of the disintegrations of the 10·7 min isomer proceed by an isomeric transition of energy $0{\cdot}056 \pm 0{\cdot}003$ eMV, presumably to the 5 yr level. In the remaining disintegrations negatrons of maximum energy $1{\cdot}25 \pm 0{\cdot}06$ eMV are emitted, probably followed by a single $\gamma$-ray of 1·50 eMV. It is shown that the decay of both isomers is consistent with accepted selection rules for $\beta$- and $\gamma$-ray transitions, indicating a high angular momentum quantum number—4 or more—for the 5 yr level and a low one for the 10·7 min level. It is pointed out that slow neutron capture by $Co^{59}$ should lead predominantly to the 5 yr level. $Co^{60}$ is a convenient substance fo laboratory $\gamma$-ray standards because of its long half-lif and practically homogeneous radiation.

539.167.3 = 3 83

**Determination of nuclear masses with the aid o β-γ-coincidences.** Bleuler, E., Scherrer, P., an Zünti, W. *Helv. Phys. Acta*, **18** (*No.* 4) 262–3 (1945) *In German.*—In the calculation of the mass of a radio active nucleus from its disintegration energy, doub may arise if the $\beta$-disintegration is accompanied by th emission of $\gamma$-quanta, since it is uncertain whether th $\gamma$-energy is to be added to the maximum $\beta$-energy o not. Absorption measurements of $\beta$-$\gamma$-coincidence make it possible to decide the question. Examples ar given. In the case of $Al^{28}$ and $Mg^{27}$ the $\beta$- and $\gamma$ energies are to be added. A preliminary value for th disintegration energy of $N^{16}$ is $9{\cdot}5 \pm 1$ eMV. A. J. M

539.167.3 = 3 83

**Two activities, $S^{37}$ and $P^{34}$, induced in chlorine b rapid neutrons.** Zünti, W., and Bleuler, E. *Helv Phys. Acta*, **18** (*No.* 4) 263–5 (1945). *In German.*— The half-life of $P^{34}$ has been redetermined to b $12{\cdot}4 \pm 0{\cdot}2$ sec. $S^{37}$ with a half-life of $5{\cdot}04 \pm 0{\cdot}02$ min has also been obtained by bombardin chlorine with rapid neutrons. A strong $\gamma$-radiatio (2·8 eMV) is also present in the latter case. A. J. M

539.167.3 = 3 83

**Disintegration scheme of scandium 46.** Meitner, L *Ark. Mat. Astr. Fys.*, **32 A** (*Paper* 6) 11 *pp.* (1945) *In German.*—Investigation of the disintegration o $Sc^{46}$ confirms the emission of two groups of $\beta$-rays The $\beta$-$\gamma$-coincidences follow the $\beta$-absorption curve so that the $\gamma$-rays belong to the process $Sc^{46} \rightarrow Ti^{46}$. Each $\beta$-transition is accompanied by the emission o one $\gamma$-ray. Transition to $Ca^{46}$ by taking up a $K$ electron was demonstrated with a network counter The disintegration scheme is

$$Ca^{46} \leftarrow Sc^{46} \xrightarrow[0{\cdot}26 \text{ eMV}]{\beta} Ti^{46} \xrightarrow[1{\cdot}5 \text{ eMV}]{\gamma} Ti^{46}$$

A. J. M

539.172 83

**Width of resonance process in $B^{11}$.** Marvin, J. F *Phys. Rev.*, **68**, 228–9 (*Nov.* 1 *and* 15, 1945).—Dis integration of $B^{11}$ to $Be^8 + He^4$ showed a shar resonance for $162 \pm 1$ kV protons [see Abstr. 8 (1941)]. The $^1/_2$-width at $^1/_2$-maximum is less tha 5·5 kV [see *Phys. Rev.*, **59**, 108 (1941)].

539.172.3 : 539.185 83

**On the angular distribution of neutrons in the photo disintegration of the deuteron.** Graham, G. A. R and Halban, H., Jr. *Rev. Mod. Phys.*, **17**, 297–30 (*April–July*, 1945).—A source of radiothorium wa placed near a small sphere of $D_2O$ and the relativ intensity of the photo-neutrons emitted at 0°, 90° an 180° to the disintegrating $\gamma$-ray was determined b two $BF_3$ chambers surrounded by paraffin. Correc tions for geometrical conditions, scattering by th room, and scattering by the $D_2O$ were applied Assuming that the angular distribution can b described by a spherically symmetrical componer and a $\sin^2$ component, the cross-section $\sigma_a$, for th

former is $(0{\cdot}39 \pm 0{\cdot}12) \times \sigma_{total}$. Using the value $10^{-27}$ cm² for $\sigma_{total}$ (which may be too low), $\sigma_a$ is $(3{\cdot}9 \pm 0{\cdot}12) \times 10^{-28}$ cm². A. J. M.

539.185 840

**On the scattering of fast neutrons by protons.** Pais, A. *Proc. Camb. Phil. Soc.*, **42**, 45–54 (*Jan.*, 1946).—Hulthén recently showed [Abstr. 1146, 1147 (1944)] that Amaldi's experimental results on the scattering [*Naturwissenschaften*, **48**, 39 (1942)] are irreconcilable with the symmetrical form of the mixed theory of Møller and Rosenfeld [*K. Danske. Vidensk. Selsk. Mat. Fys. Medd.*, **17**, 8 (1940)]. It was pointed out that the approximation involving the *S*- and *P*-waves only is too rough and higher phases must be considered. A method for computing the *D*- and higher phases is now described. This holds generally in all cases in which the average interaction potential between the scattered particle and the scattering centre is small compared with the influence of the centrifugal force. The results are applied to two cases in which the radial interaction is given by Yukawa's potential, (1) the symmetrical mixed theory and (2) the neutral mixed theory. L. S. G.

539.185 : 537.534.74 : 539.152.1 *see Abstr.* 826

539.185 : 539.172.3 *see Abstr.* 839

539.185.7 841

**Absorption of thermal neutrons in indium.** Feeny, H. *Canad. J. Res. A*, **23**, 73–6 (*Sept.*, 1945).—Absorption by In leads to the formation of 3 radioactive periods, whose half-lives are 13 sec, 54 min, and 48 days. The relative contributions of these periods to the total capture cross-section of In for thermal neutrons has been measured and found to be 37, 58 and 5%, respectively.

## STRUCTURE OF SOLIDS 539.2

539.213.29 : 666.1 : 620.178.72 842

**The behaviour of laminated and toughened glass under impact by a falling bolt.** Haward, R. N. *J. Soc. Glass. Tech.*, **29**, 197–8(*T*) (*June*, 1945).—[Abstr. 477 B (1946)].

539.215 : 536.631 *see Abstr.* 782

539.215.4 : 621.775.7 843

**The determination of particle size in powder metallurgy.** Kalischer, P. R. *Trans. Electrochem. Soc.*, **85**, 153–62 (1944).—[Abstr. 665 B (1946)].

539.23 : 547.21 : 548.74 *see Abstr.* 906, 907

## ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.313 844

**Finite strain in aelotropic elastic bodies. I.** Seth, B. R. *Bull. Calcutta Math. Soc.*, **37**, 62–8 (*June*, 1945).—The theory of finite strain, previously developed for isotropic bodies [Abstr. 2317 (1939)] is extended to some types of crystalline aelotropic bodies which can be deformed to such an extent, exceeding the elastic limits, that the small strain theory cannot be applied. Two examples are considered. One relates to an aelotropic cylinder. A uniform tension applied to its plane ends can produce a shearing stress, but this cannot happen when the cylinder is isotropic. The application of a hydrostatic pressure is also considered. In the second example an initially plane rectangular plate is bent into the form of a circular cylinder with two edges as generators. It is concluded that this bending should be possible by applying couples only in the straight edges. L. S. G.

539.313 845

**Strain hardening under combined stresses.** Prager, W. *J. Appl. Phys.*, **16**, 837–40 (*Dec.*, 1945).—Experimental investigations of the strain hardening of metals under combined stresses are usually conducted so that the directions of the principal stresses as well as the ratios of their magnitudes remain constant during any one test. The paper is concerned with incompressible isotropic materials which are stressed in this manner and deform in accordance with certain postulates. The most general stress-strain relation which can arise under these circumstances is established, and some special cases of this relation are discussed.

539.319 : 620.178.4 846

**Lapped bar splices in concrete beams.** Kluge, R. W., and Tuma, E. C. *J. Res. Nat. Bur. Stand., Wash.*, **35**, 187–218 (*Sept.*, 1945).

539.319 = 3 847

**The load in the flanges of joists.** Amstutz, E. *Schweiz. Arch. angew. Wiss. Tech.*, **11**, 26–32 (*Jan.*, 1945). *In German.*—In building construction, the structural members frequently consist of stressed plates, such as occur in built-up girders. A simple elemental plate is considered mathematically, the plate being subjected to a force parallel to one of its edges, and also to a torque. The theoretical work shows that the flange stress limits are not attained when distortion of the flange plate occurs, the total stress consisting of the flow limit plus the stress causing distortion of the plate, so that there is actually something in reserve. A. C. W.

539.32 : 539.89 *see Abstr.* 854, 855

539.37 = 3 848

**The universally valid law of pressure deformation.** Bendel, L. *Helv. Phys. Acta*, **18** (*No.* 6) 447–9 (1945). *In German.*

539.381 849

**Wave equations for finite elastic strains.** James, H. M., and Guth, E. *J. Appl. Phys.*, **16**, 643–4 (*Oct.*, 1945). [See Abstr. 2407 (1945)].

539.386 : 548.7 *see Abstr.* 886

539.389.3 : 678 : 620.172.212 850

**Creep and relaxation in rubber products at elevated temperatures.** Andrews, R. D., Mesrobian, R. B., and Tobolsky, A. V. *Trans. Amer. Soc. Mech. Engrs*, **67**, 569–73 (*Nov.*, 1945).—[Abstr. 470 B (1946)].

539.4 : 539.55/.56 : 620.171.32 = 3 851

**Brittleness and strength of metals at high temperatures.** Siegfried, W. *Schweiz. Arch. angew.*

*Wiss. Tech.*, **11**, 1–16 (*Jan.*); 43–60 (*Feb.*, 1945). *In German.*—[Abstr. 468 B (1946)].

539.4.01 852

**A relation between the shear constant $C_{44}$, melting point and interatomic distance of metals.** DAYAL, B. *Curr. Sci.*, **14**, 261 (*Oct.*, 1945).

539.5 853

**The methods of specifying the properties of visco-elastic materials.** ALFREY, T., AND DOTY, P. *J. Appl. Phys.*, **16**, 700–13 (*Nov.*, 1945).—Seven methods (Voigt model, Maxwell model, operator equation, mechanical impedance function, creep curve, relaxation curve and dynamic modulus function) of specifying visco-elastic behaviour are discussed. A number of exact relations between these methods of specification are worked out in detail. The majority of these relations are simple enough to be of practical value although a few are too cumbersome. Approximate relationships between the creep curve, the relaxation curve, Maxwell model and Voigt model are discussed; and numerical examples show the magnitude of errors introduced by the approximation to be small even in quite unfavourable cases. A consideration of the practical utility and physical meaning of the various methods of specification distinguishes between (1) those of general descriptive value and those of direct experimental value; (2) those useful in a phenomenological study of mechanical behaviour and those more suited to a formulation of molecular theory. A summary of the present molecular theories is presented together with their interpretation in terms of the Voigt and Maxwell specifications.

539.55/.56 : 620.171.32 : 539.4 = 3 *see Abstr.* 851

539.89 : 539.32 854

**The compression of twenty-one halogen compounds and eleven other simple substances to 100 000 kg/cm².** BRIDGMAN, P. W. *Proc. Amer. Acad. Arts Sci.*, 76 (*No.* 1) 1–7 (1945).—The method previously used [Abstr. 2415 (1942)] to measure the compression of 17 elements to 100 000 kg/cm² is applied, with slight improvements in the method of calculation, to the chlorides, bromides, iodides and nitrates of Na, K, Rb, Cs, Ag, Tl and $NH_4$; $AgBrO_3$; and elemental S, Pb and In. Detailed tables and graphs are given. Three new polymorphic transitions are found.

A. J. C. W.

539.89 : 539.32 855

**The compression of sixty-one solid substances to 25 000 kg/cm², determined by a new rapid method.** BRIDGMAN, P. W. *Proc. Amer. Acad. Arts Sci.*, 76, (*No.* 1) 9–24 (1945).—A new method of measuring compression up to 25 000 kg/cm² is described. The substance, in the form of a pellet about $^1/_8$ in in length and radius, is enclosed in an In sheath to reduce friction, and compressed between carboloy pistons in a carboloy cylinder, the motion of the pistons being communicated by feeler rods to a gauge measuring to 0·0001 in. The cylinder is simultaneously subjected to external compression to prevent fracture. Data are given for elemental As, Cd, In, Pb, Tl and graphite; the nitrates of the alkali metals, $NH_4$, Ag and Tl; 8 of the corresponding halates and 10 of the corresponding perhalates; 15 organic compounds; and 14 rubbers. A. J. C. W.

# PHYSICAL CHEMISTRY 541

541.11 : 662.61 : 536.46 *see Abstr.* 774

## REACTION KINETICS 541.121/.128

541.123.31 : 535.324.2 856

**Liquid–liquid equilibrium data.** DENZLER, C. G. *J. Phys. Chem.*, **49**, 358–65 (*July*, 1945).—The binodal curves for the two ternary systems benzene–1-propanol–water and carbon tetrachloride–1-propanol–water were determined at 20°c. Refractive index data for these systems and for the binary system carbon tetrachloride–1-propanol are tabulated. Characteristics of end points in "cloud point" titrations are described and a method for determining plait points by the use of Bachman charts is explained.

541.123.7 857

**Determination of coexisting phases in heterogeneous systems of many components.** BECK, P. A. *J. Appl. Phys.*, **16**, 808–15 (*Dec.*, 1945).—A general investigation was made of the coexistence relationships of $n + 1$ phases in the isothermic-isobaric sections of $n$-component systems. It was found that for a given set of $n + 1$ phases there are at most only two co-existence patterns possible. As a result in $n$-component systems, as well as in ternary systems, theoretically only a single well-chosen sample has to be examined for the phases it contains in order to completely clarify the phase coexistence relationships of $n + 1$ phases whose composition is already known. The results obtained were further used to develop a general classification of the types of non-variant equilibria occurring in many component systems.

541.124 = 3 858

**Interpretation of the reaction mechanism in the decomposition between oxides and salts of oxyacids in powder mixtures. I.** JAGITSCH, R. *Ark. Kemi Min Geol.*, **15 A** (*No.* 6) *Paper* 17, 37 *pp.* (1942). *In German.*—The reaction velocities in the decomposi tions of alkaline earth oxides with salts of oxy-acid are primarily proportional to the increasing number with rise of temperature of oxide particles diffusing into the salt. Thermal effects are detected for the reaction temperatures, which indicate them to be functions of the absolute fusion-temperatures of the alkaline earth oxides. An additional influence of chemical potential on the reaction velocity is shown in a dependence of the reaction temperature on the heat of reaction of the process. The many difficulties which arise in the treatment of the reaction mechanism of such systems, when compared with the more simple procedure of lattice diffusion in good conducting materials, are discussed, and the necessity for the consideration of the velocity of nuclei formation and similar processes caused by the predominance of the phase boundary reactions, is emphasized. H. H. HO

541.124.2 859

**The initial stages of the reaction between copper and oxygen.** BANGHAM, D. H. *J. Sci. Instrum.*, **22**, 230–1 (*Dec.*, 1945).—The experiments described cover the range of variables over which the parabolic time-law is valid, and indicate the mechanism by which the cuprous oxide film is first formed, when the oxygen pressure is progressively reduced with new samples of clean electrolytic copper foil. At sufficiently low temperatures and pressures the uptake of oxygen follows a sigmoid course instead of the parabolic time-law. Annealed copper exposed to the same pressure of oxygen at the same temperature gave steady readings. These variations in behaviour are discussed. H. H. HO.

541.127 860

**Apparatus for determination of rate of oxygen absorption. With special reference to fats.** MENAKER, M. H., SHANER, M. L., AND TRIEBOLD, H. O. *Industr. Engng Chem.* (*Analyt. Edit.*), **17**, 518–19 (*Aug.*, 1945).

541.127 = 4 861

**Kinetics of the reaction of ammonia with silver chloride.** OUELLET, C. *Canad. J. Res. B*, **23**, 217–22 (*Sept.*, 1945). *In French.*—The rate of formation and decomposition of $AgCl \cdot NH_3$ was measured from 0–57°c. The reaction took place with no incubation period and had the characteristics of a diffusion process. The temperature coefficient of the formation reaction was negligible. The value of the apparent activation energy of the decomposition was $E = 10{\cdot}6$ kcal/mole, roughly equal to that of the heat of reaction: $\Delta H = 11{\cdot}1$ kcal/mole. The coloration of the salt by light did not affect the reaction. Crystallized or fused salt reacted very slowly.

541.127 = 397 862

**Some aromatic chlorhydrines.** BERQUIST, T. *Univ. Lund* (*Thesis Phys. Inst.*) 124 *pp.* (1944). *In Swedish.*—Phenylethylene, *o*-, *m*- and *p*-tolylethylene, benzylethylene and cyclohexylethylene derivatives of chlorhydrine were prepared, partially by new methods and of hitherto unobtained purity. Boiling points, densities and refractive indices (20°c) are tabulated, together with hydrolysis velocity coefficients. Since the reaction velocity in alkaline solutions of α-chlorhydrines is too great to permit of direct observation, a buffer solution (boric acid–borate) was used and the reaction velocity of spontaneous hydrolysis was also determined. A new method of determining velocity coefficients for rapid reactions is given. Michael's rule was found experimentally to hold for all the compounds examined. The various velocity coefficients are compared and the activation energy is determined for a number of the reactions. J. A. W.

## ELECTROCHEMISTRY 541.13

541.133 : 532.739.2 863

**The electrical conductivities of a number of salts and the solubilities of barium sulphate in water-ethyl alcohol solutions.** NORBERG, B., AND CLEMEDSON, C. J. *Ark. Kemi Min. Geol.*, **16 A** (*No.* 1) *Paper* 4, 9 *pp.* (1943).—The conductivities of KI, KCl, LiCl, $K_2SO_4$, $Li_2SO_4$ and $LaCl_3$ in a number of $C_2H_5OH$–$H_2O$ mixtures were determined (using the Kohlrausch–Arrhenius technique). The limiting equivalent conductivities and the ionic mobilities were calculated, and these values studied with regard to viscosity (Walden's rule), solvation and the Onsager theory. The results are given in tables. These values were used for the calculation of the solubility of $BaSO_4$ in $C_2H_5OH$–$H_2O$ mixtures from measurements of the conductances of the saturated solutions.

541.134 : 620.193 864

**Electrochemical measurements for corrosion studies.** GILBERT, P. T. *J. Sci. Instrum.*, **22**, 235–7 (*Dec.*, 1945).—The nature of the measurements which the electrochemist desires to make in corrosion studies, and the aid which the physicist can bring to this work is indicated. For this purpose, the behaviour of 4 pairs of coupled metals in Metropolitan Water Board tap water was followed to establish the relationship between them as they corroded under various conditions of temperature and concentration of dissolved oxygen and carbon dioxide. Methods of measurement are described and the problem of voltage stabilization is discussed. If the corrosion taking place is entirely or largely electrochemical, the corrosion current is directly related to the amount of corrosion. When 2 metals such as Zn and Fe are corroding in contact, an unknown factor is generally introduced. Local cathodes on the anode and local anodes on the cathode, will cause an increase in the corrosion over that due to the passage of current between anodic and cathodic electrodes. With a single metal, these local elements will cause most, or all, of the corrosion, but when an electropositive and an electronegative metal are coupled, the effect may be only a secondary one. H. H. HO.

541.138 : 541.486 : 535.243 = 397 *see Abstr.* 736

541.138.3 : 621.357.3 865

**The electrolytic reduction of acetophenone in alkaline solution.** SWANN, S., JR., AMBROSE, P. E., DALE, R. C., ROWE, R. C., WARD, H. M., KERFMAN, H. D., AND AXELROD, S. *Trans. Electrochem. Soc.*, **85**, 231–7 (1944).—[Abstr. 588 B (1946)].

## PHOTOCHEMISTRY 541.14

541.144 866

**The production and decomposition of ozone by low-pressure mercury vapour lamps.** KOLLER, L. R. *J. Appl. Phys.*, **16**, 816–20 (*Dec.*, 1945).—A photo-tube method for measuring the concentration of $O_3$ is described. Measurements were made of the rate of production and of decomposition of $O_3$ in $O_2$ and in air by low-pressure Hg vapour lamps. The production in $O_2$ is enhanced by the presence of nitrogen. Increasing the moisture content of the gas decreases production and increases decomposition. A new germicidal lamp enclosed in a 10 litre glass tube will form an equilibrium concentration of 145 p.p.m. by volume. A quartz lamp under the same conditions will form 640 p.p.m. With $O_2$ flowing through the tube the yield for the quartz lamp is $2{\cdot}5 \times 10^{-3}$ g.$O_3$/min. or 10 g/kWh.

541.144.7 : 581.132 867

**Photosynthetic activity of isolated chloroplasts.** FRANCK, J. *Rev. Mod. Phys.*, **17**, 112–19 (*April–July*,

1945).—This paper is a progress report, and contains an interpretation on kinetic theory of the photosynethetic activity of whole plants. Examples are: measurements of the rates of gas exchange as function of light intensity in continuous irradiation and in flashing light; measurements of quantum yield; measurements of the influence of poisons, temperature, and of surplus or deficit of carbon dioxide; influence of excess or deficiency of oxygen in the atmosphere, and of an atmosphere consisting of pure hydrogen with an admixture of carbon dioxide; measurements of the intensity of chlorophyll fluorescence and its relation to the photosynthetic activity. The chloroplasts, which are the catalysts involved, are supposed to contain the whole photosynthetic apparatus, and the main purpose of the discussion is to show that measurements of the rate curves of oxygen production by isolated chloroplasts are possible, and that their shape indicates lack of substances styled RH which are metabolic products. It is suggested that the chemical nature of the carbon dioxide acceptor RH may be identified by such measurements. H. H. HO.

## COLLOIDS . ADSORPTION 541.18

541.18 : 535 : 534.39 = 4 *see Abstr.* 727

541.18 : 537.363 868

**A new electrophoresis apparatus for preparative purposes.** SVENSSON, H. *Ark. Kemi. Min. Geol.*, **15 B** (*No.* 5) *Paper* 19, 8 *pp.* (1942).

541.182.4 : 532.517.4 869

**The mechanism of emulsion formation in turbulent flow.** CLAY, P. H. *Proc. Ned. Akad. Wet.*, **43** (*No.* 7) 852–65; (*No.* 8) 979–90 (1940).—In the mechanical preparation of an emulsion from a coarse dispersion of two fluids by laminar or turbulent motion two elementary processes are operative: a droplet of the dispersed phase may be broken up into a number of smaller droplets or may coalesce with others to form a larger droplet. The mechanism of these processes is studied experimentally by short-period illumination and magnification of the droplets subjected to turbulent flow through a tube of 10 cm dia. or between coaxial cylinders, the inner of which is set in rotation. It is shown that the droplets retain, to a very considerable degree, their spherical shape when subjected to the violent motion. The turbulent disintegration of the droplets resembles the process of atomization in a Diesel engine and can be considered as attributable to fluctuations of static pressure. A rough approximation to the upper limit of size of droplets produced by disintegration is deduced. J. S. G. T.

541.182.5 870

**A new method for measuring the time of setting of gel-forming systems.** HATTIANGDI, G. S., AND DHARMATTI, S. S. *Curr. Sci.*, **14**, 300–1 (*Nov.*, 1945).

541.183 : 535.417 871

**Adsorption analysis by interferometric observation.** TISELIUS, A., AND CLAESSON, S. *Ark. Kemi. Min. Geol.*, **15 B** (*No.* 5) *Paper* 18, 6 *pp.* (1942).—The micro-interferometer described for adsorption analysis of colourless solutions in water or organic solvents is designed for continuous concn. observations in a small vol. at the filter outlet, so that errors due to convection are eliminated. Typical curves of refractive index plotted against vol. adsorption are given and briefly discussed. N. M. B.

541.183.1 : 532.61 *see Abstr.* 708

541.183.24 : 541.6 = 3 872

**The adsorption of amine ions on colloidal silver iodide.** BODFORSS, S. *Lunds Univ. Årsskr.*, **39** (*No.* 12) 20 *pp.* (1944). *K. Fysiogr. Sällsk. Handl.*, **54** (*No.* 12) 20 *pp.* (1944). *In German.*—When a silver solution is added to a KI solution coloured red by metanil yellow, a blue colour is developed which is ascribed to molecular distortion in adsorption, whereby the metanil yellow acts as protective colloid. Other silver halogenides also give adsorption colours, although in lesser degree. The extinction curves (6 000–4 000 Å) of metanil yellow in HCl and $H_2SO_4$ are compared with that for the AgI standard sol. Only the blue solution in $H_2SO_4$ shows any similarity to the sol. Inorganic electrolytes flocculate the sol with a blue colour. The displacement effect of some amino salts was determined by titration. A relation between adsorption and structure is discussed. J. A. W.

541.183.56 873

**Hysteresis in the physical adsorption of nitrogen on bone char and other adsorbents.** GLEYSTEEN, L. F., AND DEITZ, V. R. *J. Res. Nat. Bur. Stand., Wash.*, **35**, 285–307 (*Oct.*, 1945).—It was found that hysteresis at 77·4°K became less pronounced in the order: bone char, activated carbon, silica gel and coconut-shell charcoal, occurring only slightly in coconut-shell charcoal and only from high relative pressures in the pressure range in which the Langmuir equation was not obeyed. It was shown to be highly probable that a true steady state was attained in the pressure determinations and that the time dependency of adsorption and desorption are compatible with the requirements of diffusion processes. Theories of hysteresis are reviewed on the basis of capillary condensation, and an alternative interpretation is suggested in terms of the theory of multimolecular adsorption.

## CHEMICAL STRUCTURE 541.2/.6

541.24 : 532.712 *see Abstr.* 712

541.486 : 541.138 : 535.243 = 397 *see Abstr.* 736

541.6 : 541.183.24 = 3 *see Abstr.* 872

541.66/.67 : 537.226.8 *see Abstr.* 790

541.67 : 538.224 874

**The magnetic susceptibility of position isomers in the disubstituted benzene series.** FRENCH, C. M. *Trans Faraday Soc.*, **41**, 676–85 (*Nov.–Dec.*, 1945).—The diamagnetic susceptibility values for various isomeric disubstituted benzenes were determined using the Gouy method. It is shown that the *o*-compound has the highest susceptibility of the 3 isomers when the substituent is *o–p* directing, and the *m*-compound

hen the substituent is *m*-directing. A tentative xplanation is put forward. Certain other quantitative ifferences are noted between compounds containing *p* directing groups and those containing *m*-directing roups, and the apparently anomalous effect due to the resence of a nitro-group is noted.

## CHEMICAL ANALYSIS 543/545

43 : 669.9 875

**Some applications of vacuum distillation technique in e analysis of alloys.** PRICE, J. W. *J. Soc. Chem. d.*, **64**, 283–5 (*Oct.*, 1945).—The determination of lloy constituents by loss of weight on vacuum stillation was successfully applied to Zn in Sn–Zn lloys, Pb in Sn–Pb solders, P in P–Sn, Zn in brass ad gunmetals, Pb in Cu–Pb and gunmetals, and Cd Cd–Cu. The effects due to the presence of P in u-base alloys and Sb in solder were elucidated.

45.37 876

**The use of the polarograph in the determination of nall amounts of nitrate in sodium nitrite.** HASLAM, ., AND CROSS, L. H. *J. Soc. Chem. Ind., Lond.*, **64**, 59–60 (*Sept.*, 1945).

45.7 : 545.827 *see Abstr.* 879

45.82 877

**Gas cell for Beckman quartz spectrophotometer.** OGGESHALL, N. D. *Industr. Engng Chem.* (*Analyt. dit.*), **17**, 513–14 (*Aug.*, 1945).—A double-compart-ent gas-absorption cell is described. The assembly onsists of a machined brass block, quartz windows, nd packless valves connected to standard ground-lass joints.

45.827 : 533.15 : 537.54 878

**Gas flow in the mass spectrometer.** HONIG, R. E. *. Appl. Phys.*, **16**, 646–54 (*Nov.*, 1945).—If a mass pectrometer is to be used successfully for gas analyses, he gas flow through the system must meet a number f requirements. The three modes of gas flow—olecular, intermediate and viscous—are reviewed, nd their working ranges are discussed in terms of the ressure of the system. The upper limit for molecular ow, through capillaries or through small openings, es at a pressure where the m.f.p. of the molecules is 5–40 × the diameter. Expressions are developed to ow that, for molecular flow, the ion beam intensity s independent of mol. wt. but is a linear function of he sample pressure, and that the principle of linear uperposition applies to mixture peaks. Since the omposition of a gas mixture in a reservoir is found to hange with time (a numerical example is worked out), he necessity for analyses of short duration becomes vident. The practical aspects of designing the gas system for molecular flow and for efficient ion production are discussed in detail. The various flow requirements are best met by a gas leak consisting of a small hole in a diaphragm, or several holes in parallel. A relatively high gas pressure within the electron beam boundaries and resulting large ion currents are produced by introducing the gas as a molecular beam into a gas-tight ionizing region.

545.827 : 545.7 879

**Analysis of gas mixtures with the mass spectrometer.** FARMER, E. C. *Amer. Phys. Soc.* (*Proc., Oct.*, 1945). *Abstr. in Phys. Rev.*, **68**, 235 (*Nov.* 1 *and* 15, 1945).

545.828 : 535.243 *see Abstr.* 737

545.83 = 397 880

**Titration and photometric micro-determination of alcohol.** SMITH, L. *Lunds Univ. Årsskr.*, **39** (*No.* 11) 18 *pp.* (1944). *K. Fysiogr. Sällsk. Handb.*, **54** (*No.* 11) 18 *pp.* (1944). *In Swedish.*—Modifications to Widmark's method, important in forensic chemistry, are proposed, using dichromate in aqueous solution, added to concentrated $H_2SO_4$. The mixture is used for oxidation and as absorption medium. The chromic acid residue is reduced with arsenious acid, the residue of which is determined with potassium bromate. The procedure is described and errors discussed. A series of examples is given. The error in a single determination is ±1% using a pipette and ±2½% using burette. Determinations with a Pulfrich photometer are described. J. A. W.

545.84 881

**Displacement development in adsorption analysis.** TISELIUS, A. *Ark. Kemi Min. Geol.*, **16 A** (*No.* 5) *Paper* 18, 11 *pp.* (1943).—When a sample containing a mixture of different substances is displaced through a column of an adsorbent by adding a solution of a substance with higher adsorption affinity than any of the components present, a stationary state gradually develops which does not change however long the column. In this state the components have separated from each other completely and adjusted themselves to characteristic concentrations which depend only upon the displacement substance concentration and the nature of the adsorbent, and are independent of the other substances present and the original concentration in the sample. The volume of each portion is thus ∝ the amount of the corresponding substance. The stationary concentrations can be deduced from the adsorption isotherms by a simple graphical construction. This procedure is well suited for adsorption analysis by interferometric observation but is also of value for preparative separations, as it requires a minimum amount of adsorbent and developer.

547.21 : 539.23 : 548.74 *see Abstr.* 906, 907

# CRYSTALLOGRAPHY 548

548.0 : 536.424.1 = 3 882

**Displacement of the jump in the $NH_4$ rotation ransformation.** BÄRTSCHI, P., MATTHIAS, B., MERZ, V., AND SCHERRER, P. *Helv. Phys. Acta*, **18** (*No.* 4) 38–40 (1945). *In German.*—Some of the $NH_4$ ions n $NH_4H_2PO_4$ were replaced by Tl ions, Tl being selected because it has nearly the same ionic radius as $NH_4$. Mixed crystals were produced with 19 mol.% of Tl and with these the transformation point was displaced about 53°C towards lower temperatures, as compared with $NH_4H_2PO_4$. For all crystals of the Rochelle-salt type the natural resonance

frequency has a maximum value, corresponding to a zero temperature coefficient, but for the phosphates the temperature at which this occurs is too low to be of practical value. With the mixed crystals having 19% Tl, however, this temperature is raised about 14°C.

A. W.

548.0 : 537.228.1 = 3 883

**New piezoelectric modification of rubidium phosphate,** Bärtschi, P., Matthias, B., Merz, W., and Scherrer. P. *Helv. Phys. Acta*, **18** (*No.* 4) 240–2 (1945). *In German.*—Investigation of $RbH_2PO_4$ shows that two crystal modifications may be obtained, a monoclinic or rhombic form (optically biaxial) and a tetragonal form. The latter exhibits similar properties to those of the isomorphous K salt. The permittivity of the powdered material shows a well-defined maximum at −126°C. Provisional measurements on single crystals indicate piezo-electric properties of the Rochelle-salt type in the direction of the *c*-axis. Below the Curie point of −126°C there is in this direction spontaneous polarization and electric hysteresis. The behaviour along the *a*-axis is qualitatively similar to that of $KH_2PO_4$, the permittivity slowly rising with decreasing temperature towards the Curie point and there falling suddenly. A. W.

548.0 : 538.23 *see Abstr.* 817

548.24 : 548.73 *see Abstr.* 905

548.3 = 3 884

**The chemical variability of a crystal type and its technical importance.** Niggli, P. *Schweiz. Arch. angew. Wiss. Tech.*, **11**, 65–77 (*March*); 103–15 (*April*, 1945). *In German.*—A non-technical description of the variability of crystals. The first part deals mainly with variations in which the crystal remains perfect, including the phase sequence in Cu–Zn alloys, deformation of the rock-salt structure in NaCN and $BaSO_4$, order-disorder transitions (sometimes accompanied by changes in symmetry), and simple solid solutions. The second part is concerned with structures containing empty sites (γ-brass, FeO, etc.), interstitial structures, variable aluminosilicates (e.g. the amphiboles), layer structures, small-scale twinning, and the mosaic structure of crystals. Both parts are well illustrated with photographs and drawings.

A. J. C. W.

548.5 885

**"Stimulation crystals" and twin-formation in recrystallized aluminium.** Burgers, W. G. *Nature, Lond.*, **157**, 76–7 (*Jan.* 19, 1946).

548.7 : 537.227 : 530.145 *see Abstr.* 688

548.7 : 539.386 886

**Lattice distortions and shear in aluminium single crystals.** Burgers, W. G., and Lebbink, F. J. *Nature, Lond.*, **157**, 47 (*Jan.* 12, 1946).

548.73 887

**The crystal structure of $Al_8Si_6Mg_3Fe$.** Perlitz, H., and Westgren, A. *Ark. Kemi Min. Geol.*, **15 B** (*No.* 5) *Paper* 16, 8 *pp.* (1942).

548.73 88

**The lattice parameters of the cubic $As_2O_3$ an $Sb_2O_3$.** Almin, K. E., and Westgren, A. *Ark. Kem Min. Geol.*, **15 B** (*No.* 5) *Paper* 22, 6 *pp.* (1942).

548.73 88

**An X-ray investigation of the systems $CaO–Bi_2O_3$ $SrO–Bi_2O_3$ and $BaO–Bi_2O_3–O$. (Mixed oxides wit a defect oxygen lattice.)** Aurivillius, B. *Ark. Kem Min. Geol.*, **16 A** (*No.* 5) *Paper* 17, 13 *pp.* (1943).

548.73 89

**Some notes on $MX_2$ layer lattices with close-packe X atoms.** Hägg, G. *Ark. Kemi Min. Geol.*, **16** (*No.* 1) *Paper* 3, 6 *pp.* (1943).

548.73 89

**On the crystal structures of cadmium bromide an cadmium iodide.** Hägg, G., Kiessling, R., and Lindén, E. *Ark. Kemi Min. Geol.*, **16 B** (*No.* 1 *Paper* 4, 9 *pp.* (1943).

548.73 89

**X-ray studies on the system $CdBr_2–CdI_2$.** Hägg, G. and Lindén, E. *Ark. Kemi Min. Geol.*, **16 B** (*No.* 1 *Paper* 5, 10 *pp.* (1943).

548.73 89

**X-ray analysis of thallium fluoantimonate TlSbF and some isomorphous alkali compounds.** Schre welius, N. *Ark. Kemi Min. Geol.*, **16 B** (*No.* 2 *Paper* 7, 5 *pp.* (1943).

548.73 89

**The crystal structure of $Al_2CuMg$.** Perlitz, H and Westgren, A. *Ark. Kemi Min. Geol.*, **16** (*No.* 5) *Paper* 13, 5 *pp.* (1943).

548.73 89

**The crystal structure of $Pb_3O_4$ and $SnPb_2O$.** Byström, A., and Westgren, A. *Ark. Kemi Mi Geol.*, **16 B** (*No.* 5) *Paper* 14, 7 *pp.* (1943).

548.73 89

**The crystal structure of braunite, $3Mn_2O_3 . MnSiO$** Byström, A., and Mason, B. *Ark. Kemi Min. Geo* **16 B** (*No.* 5) *Paper* 15, 8 *pp.* (1943).

548.73 89

**On the oxygen positions in tungstates and molybdat with the scheelite structure.** Sillén, L. G., an Nylander, A. L. *Ark. Kemi Min. Geol.*, **17** (*No.* 1) *Paper* 4, 27 *pp.* (1943).

548.73 8

**X-ray analysis of $CrVO_4$ and isomorphous cor pounds.** Brandt, K. *Ark. Kemi Min. Geol.*, **17** (*No.* 2) *Paper* 6, 13 *pp.* (1943).

548.73 8

**X-ray analysis of antimony trifluoride.** Byström, and Westgren, A. *Ark. Kemi Min. Geol.*, **17** (*No.* 1) *Paper* 2, 7 *pp.* (1943).

548.73 9

**The crystal structure of $ZnSb_2O_4$ and isomorph compounds.** Ståhl, S. *Ark. Kemi Min. Geol.*, **17** (*No.* 2) *Paper* 5, 7 *pp.* (1943).

548.73 901

**X-ray studies on orthorhombic PbO.** BYSTRÖM, A. *Ark. Kemi Min. Geol.*, **17 B** (*No.* 2) *Paper* 8, 6 *pp.* (1943).

548.73 902

**Optical and X-ray diffraction studies of certain calcium phosphates.** BALE, W. F., BONNER, J. F., HODGE, H. C., ADLER, H., WREATH, A. R., AND BELL, R. *Industr. Engng Chem.* (*Analyt. Edit.*), **17**, 191–5 (*Aug.*, 1945).—The X-ray diffraction data, the melting points, the crystallographic systems, and the indices of refraction of 11 Ca phosphates are reported. These are divided into 4 groups: a primary Ca phosphate and 3 derivatives, a secondary Ca phosphate and 3 derivatives, 2 tertiary Ca phosphates and hydroxylapatite.

548.73 : 536.413 903

**The thermal expansion of graphite from 15°C to 800°C: I. Experimental. II. Theoretical.** NELSON, J. B., AND RILEY, D. P. *Proc. Phys. Soc., Lond.*, **57**, 477–95 (*Nov.*, 1945).—The variation with temperature of the $a$ and $c$ unit-cell dimensions of hexagonal Ceylon graphite has been measured over the temperature range 15°–800°C by the X-ray powder method. At 14·6°C, $a = 2\,456{\cdot}2 \pm 0{\cdot}1$ X.U. $c = 6\,694{\cdot}3 \pm 0{\cdot}7$ X.U. The carbon-carbon bond length, C–C = $1{\cdot}4210 \pm 0{\cdot}0001$ Å. The $a$ dimension shows a slight contraction up to about 400°C, a small expansion occurring above this temperature. The thermal expansion in the $c$ direction is large; the average value for $a$ over the temperature range is $28{\cdot}3 \times 10^{-6}$. The complex nature of the expansion in both directions is discussed qualitatively.

A theory of the thermal expansion of hexagonal crystals is derived, and shown to account quantitatively for the experimental data on graphite. Certain of the elastic moduli for graphite are estimated to be at 18°C approximately: $s_{11} + s_{12} = 1{\cdot}8 \times 10^{-13}$, $s_{13} = -4{\cdot}3 \times 10^{-13}$, $s_{33} = 58{\cdot}5 \times 10^{-13}$ cm/dyne. Hence the two linear compressibilities are, at 18°C approximately: $\kappa_\perp = -2{\cdot}5 \times 10^{-13}$ cm²/dyne; $\kappa_\parallel = 50 \times 10^{-13}$ cm²/dyne.

548.73 : 537.226.8 : 536.424.1 = 3 *see Abstr.* 773

548.73 : 539.133 904

**The crystal structure of coronene: A quantitative X-ray investigation.** ROBERTSON, J. M., AND WHITE, J. G. *J. Chem. Soc.*, 607–17 (*Sept.*, 1945).—The monoclinic crystals, space group $P2_1/a$, have two planar, centro-symmetrical molecules of $C_{24}H_{12}$ per unit cell, and the molecular planes are inclined at about 44° to the (010) plane. The distance between the molecular planes is 3·40 Å. The C–C bond length varies in different parts of the molecule. For the central ring and the "spokes" connecting it to the outer edges this distance is 1·43 Å. The outer bonds are of two types, measuring 1·38 Å and 1·41 Å, severally. The accuracy of these determinations is estimated to lie between ±0·01 and ±0·02 Å, and they represent the first definite measurements of variable C–C bond length for any condensed ring aromatic hydrocarbon. Reference is made to molecular orbital calculations on this problem, and it is also discussed in terms of the 20 stable valency bond structures for coronene. This treatment provides a qualitative account of the bond length variations observed.

548.73 : 548.24 905

**X-ray analysis of twinned MnP crystals.** FYLKING, K. E. *Ark. Kemi Min. Geol.*, **17 A** (*No.* 2) *Paper* 7, 9 *pp.* (1943).

548.74 : 547.21 : 539.23 906

**Structure and orientation in thin films of polythene.** CHARLESBY, A. *Proc. Phys. Soc., Lond.*, **57**, 496–509 (*Nov.*, 1945).—Thin films of polythene on hot water prepared by evaporation of a dilute solution in xylene are crystalline in character. The structure of these films is similar to that of the hydrocarbon described by Bunn, with the following axial spacings in the orthorhombic unit cell: $a = 7{\cdot}428$ Å, $b = 4{\cdot}9324$ Å, $c = 2{\cdot}532$ Å. In addition, however, the molecules are oriented by the action of the hydrophilic end-group $-CH = CH_2$, which can only be incorporated in the structure if the molecules are tilted, so that the $b$ axis is parallel to the water surface, while the $c$ axis makes an angle of 56° instead of 90° with the water surface. The crystalline character of these thin films of about 1 000 Å thickness contrasts with the amorphous structure of polythene in the bulk form. The films may be stretched, and their structure is found to consist of crystals in which the $c$ axis lies nearly parallel to the direction of the applied stress. Intermolecular forces probably stabilize the crystals in their new positions, until the temperature is raised to the neighbourhood of the melting point, when the film reverts to its initial orientation. Polythene emulsion structure shows great similarity to that of liquid polythene, and has an amorphous character with, however, some evidence of a small proportion of crystalline polythene.

548.74 : 547.21 : 539.23 907

**Effect of temperature on the structure of highly polymerized hydrocarbons.** CHARLESBY, A. *Proc. Phys. Soc., Lond.*, **57**, 510–18 (*Nov.*, 1945).—An investigation on polythene was made from the temperature of liquid oxygen to temperatures at which polythene exists in the liquid condition. As with much lower polymers, the ratio $a/b$ of the two axes increases with temperature, and tends to the value for a pseudo-hexagonal structure, but this value is never attained, since fusion sets in first. A change from a crystalline to an amorphous pattern occurs at temperatures which are below those generally taken as the melting point, but which agree with that for which polythene transforms from a wax-like to a more transparent solid. The transition of structure extends over a number of degrees, and in this interval crystalline and amorphous patterns are superimposed. Orientation present in crystalline films is retained when the films are heated to temperatures well above the melting point, and subsequently cooled.

549.211 : 535.343.2–15 *see Abstr.* 754

# GEOPHYSICS 55

550.31 908

**A kinetic theory on the origin of orogenic forces.** FISHER, J. E. *Amer. J. Sci.*, **243**, 606–13 (*Nov.*, 1945).—Disturbance of the earth's axis of gyration is considered as a possible cause of crustal deformation. It is shown that tilting of this axis by 10′, or a small translation of the axis, would be quantitatively sufficient for the results displayed in the great orogenic belts. As the initiating cause, levelling of great highlands by erosion, with transfer of the debris through moderate distances, would disturb the axis of gyration and thus set up new orogenic forces. Such an interplay of action and reaction may explain the succession of orogenic episodes through geologic time.

550.34 909

**Seismicity of the earth.** GUTENBERG, B., AND RICHTER, C. F. *Bull. Geol. Soc. Amer.*, **56**, 603–68 (*June*, 1945).—This paper supplements "Seismicity of the Earth" [*Geol. Soc. Am., Spec. Papers*, **34** (1941)]. Additional epicentres for shallow and deep earthquakes are reported. Sixty-four great earthquakes are now identified for 1904–1943, and 201 major earthquakes for 1922–1943. New maps are given. Relative seismicity of active regions is discussed quantitatively (shallow shocks only). The Pacific belt has about 80% and the trans-Asiatic zone about 10% of the general activity. Earthquakes, volcanism and gravity anomalies are discussed in their geographical and dynamical relation to structural arcs of Pacific type. These must be maintained by persistent processes in which subcrustal currents play a part.

550.341 : 621.317.39 : 534.647 = 82 *see Abstr.* 731

551.463 : 535.43 : 535.341 *see Abstr.* 752

## METEOROLOGY 551.5

551.510.535 910

**Note on diffusion in the ionosphere.** JAEGER, J. C. *Proc. Phys. Soc., Lond.*, **57**, 519–23 (*Nov.*, 1945).—The equation of diffusion for a one-dimensional region in which the coefficient of diffusion varies exponentially is solved, and the results applied to the diffusion of ions in the ionosphere. Recombination and the effects of the earth's magnetic field are neglected. Numerical results are given for three special initial distributions of ion density, viz. concentrations at 200 and at 400 km, and a Chapman distribution.

551.511 911

**Radiative equilibrium of the atmosphere and the thermal structure of the troposphere.** ANANTHAKRISHNAN, R. *Curr. Sci.*, **14**, 298–9 (*Nov.*, 1945).

551.511 = 3 912

**Some remarks on the relation between temperature and velocity changes in the free atmosphere and changes in ground barometric pressure.** THRANE, P. *Met. Ann.*, **1** (*No.* 4) 85–100 (1942). *In German.*—The equations of motion of a stationary circular vortex over the north pole, co-axial with the earth, are established and the conditions that the nucleus of an anticyclone (cyclone) is warm (cold) at all heights are deduced. Using variational calculus, the effect on ground pressure of change in the velocity field by constant temperature is discussed and it is shown that the effect of temperature change by constant velocity is indeterminate. With reference to previous literature it is stated that it is not possible to discriminate between primary and secondary phenomena or to separate thermal and dynamic effects, except in the case of a mass of air bounded by fronts, where the primary causes of variation in temperature, pressure and velocity are radiation and impulse from surrounding masses. J. A. W.

551.515.1 913

**On the deepening of a polar front cyclone.** FJØRTOFT, R. *Met. Ann.*, **1** (*No.* 1) 1–44 (1942).—After a general discussion of possible and current methods of forecasting, it is shown that the usual method, based on empirical knowledge of the development of the wind system of polar front cyclones, breaks down at the initial stage of the cyclone owing to the spontaneous character of formation from a fundamental velocity field, and to leaving out of account (1) the relation between strength of cyclonic development and discontinuity of tangential velocity at the front, (2) the wind increase in the troposphere. The equations of vertical equilibrium are established and used to discuss the variation in the isobar system around a deepening cyclone in the wave stage and in the early occlusion stage. A close connection is found between the horizontal expansion within the air masses and the up- and down-gliding processes at the front surfaces. The deepening of a cyclone is characteristic of the instability of its development and corresponds to horizontal divergence in the troposphere. Using the equation of horizontal motion it is shown that the formation of the upper wave and the distribution of vertical velocities in the tropospheric field with increasing westerly winds are both connected with horizontal divergence. Vertical increase of the zonal wind and tendency to deepening is greater, the greater the polewards decrease of temperature. Discussing the stability of a vortex, it is shown that the stratosphere is always stable and that the stability of the troposphere depends on the temperature lapse rate. J. A. W.

551.515.1 = 3 914

**Aerological study by radiosondes in Tromsö 31 March–30 April, 1939.** JOHANSEN, H. *Met. Ann.*, **1** (*No.* 2) 45–65 (1942). *In German.*—A thermoisopleth diagram shows the variation of fronts, tropopause surfaces, shrinking inversions and isotherms while an Arctic front cyclone approached northern Norway from N.W., passing S.W. of Tromsö on 2 April, followed by Arctic-air eruption. The march of the meteorological elements is described in detail (1–30 April) and the Arctic, polar and tropic air masses are traced. There seems to be no difference between north- and mid-European phenomena of this kind. The Arctic air covers the lower 1–2 km, the tropic air fills the higher portion of the troposphere and the polar air fills the largest space, between the two others. The temperature change in the warm air masses on their way north increases with height. The data are divided in groups according to rise or fal

n ground barometric pressure and it is shown that tratosphere temperature and tropopause height scillate in phase opposition. Ozone measurements re treated on the same basis and it is shown that a egative correlation exists between ozone quantity and ropopause height, a positive correlation between zone quantity and lower stratosphere temperature, nd the ozone quantity depends on the ground arometric pressure variation. Possible explanations re discussed. J. A. W.

551.515.8 = 3 915

**The cold wave in south Norway, 15 January, 1940.** JAESS, L. *Met. Ann.*, **1** (*No.* 3) 67–84 (1942). *In German.*—The march of meteorological elements from 3–16 January is described in detail and a method f determining direction and velocity of propagation f the cold front is given. For determining the height, Löppen's formula gives too high, Haurwitz's formula oo low, a value. A more accurate formula is tablished, and a method of determining the height y mountain observations, assuming a linear front of onstant slope, is given. J. A. W.

551.553.12 : 551.576.11 916

**On the motion of the air over a mountain ridge.** LIASSEN, A. *Met. Ann.*, **1** (*No.* 5) 102–13 (1942).—üttner's description of the formation of lenticular Moazagotl) clouds over the Riesengebirge [*Beitr. z. hys. d. fr. Atm.*, **25**, 79 (1938); **25**, 251 (1939); **26**, 52 (1940)] is discussed and the assumption that ratification is indifferent is deemed untenable. eglecting viscosity and Coriolis forces and assuming y-adiabatic changes, the equations of permanent dimensional flow with small perturbations are tablished. It is supposed that every stream line onverges to horizontal asymptotes at $x = +\alpha$ and $= -\alpha$, and the vertical distance between these symptotes is shown to vary periodically with height. he results are applied to the above lenticular cloud rmation, and with numerical values corresponding normal conditions, the height of the cloud is found to be 5·5 km, in agreement with actual observations. J. A. W.

551.556.4 917

**Occurrence of summer dust over Delhi.** SEN, A. *Curr. Sci.*, **14**, 260–1 (*Oct.*, 1945).

551.575 : 629.13 : 621–788.2 918

**Fog dispersal from airstrips.** LYNN, H. R. *Engng J., Montreal*, **28**, 634–40 (*Oct.*, 1945).—[Abstr. 490 B (1946)].

551.576.11 : 551.553.12 *see Abstr.* 916

551.582.2 : 519.241.1 = 3 919

**Duration, intensity and frequency of cold spells in Switzerland.** RÜCKLI, R. *Schweiz. Bauztg*, **126**, 83–5 (*Sept.* 1, 1945). *In German.*—The investigation is based on observations of 3 500 cold spells, with 20 000 temperature measurements, at 7 stations in different altitudes. Assumption of linear correlation leads to a coefficient of only 0·265–0·367. With logarithmic regression, and grouping the data according to duration, weighting the shorter and more reliable periods, a correlation table (Bern) is given, horizontal entries corresponding to temperatures (below 0°C, 1 deg. intervals), the vertical columns corresponding to duration (1–3 days, 4–6 days, etc.). A fairly close correlation is now found. The table also shows the frequency of cold spells of given duration. Regression curves are given for different altitudes and the probability of cold spells of certain durations is shown in diagrams. Cold spells with short interruptions (1–2 days) of milder weather which do not affect the penetration of frost into the soil are also considered. J. A. W.

551.593.9 : 535.42 920

**Sunset shadow bands.** IVES, R. L. *J. Opt. Soc. Amer.*, **35**, 736 (*Nov.*, 1945).—Shadow bands, occasionally observed at sunset when flat desert terrain is observed from above, are here described. Diffraction of sunlight across mountain crests is suggested as the explanation.

# BIOLOGY 57/59

74 : 537.531 921

**Roentgen radiations in biological research.** PACKARD, *Radiology*, **45**, 522–33 (*Nov.*, 1945).—A 50-year urvey, including a bibliography of 75 entries.

76.8.095.14 922

**The effect of X-rays on Leishmania tropica *in vitro*.** ELDMAN-MUHSAM, B., AND HALBERSTAEDTER, L. *rit. J. Radiol.*, **19**, 41–4 (*Jan.*, 1946).

77.15.037 923

**A specific effect of high-frequency electric currents biological objects.** NYROP, J. E. *Nature, Lond.*, 57, 51 (*Jan.* 12, 1946).

78.088.5 924

**The spatial distribution of ionization in irradiated issue and its relation to biological effects.** LEA, D. E. *rit. J. Radiol.*, **16**, 338–9 (*Nov.*, 1943).—Experiments in the production of chromosome aberrations in irradiated microspores of *Tradescantia* are described which seem to show that the spatial distribution of ionization in irradiated tissue is definitely related to biological effects. A curve of anticipated efficiency (for equal ionization in tissue) of X-ray wavelengths ranging from 1 to 10 Å has been constructed. The predictions based on these calculations were tested by making irradiations at wavelengths 0·15, 1·5, 4·1 and 8·3 Å. The agreement obtained was satisfactory. This type of action is a direct action of irradiation and not the type in which the radiation ionizes some common cell constituent, probably water, activating the water, and the activated water then produces the biological effect. The spatial distribution of ionization is best understood in the direct type of action.

578.088.9 : 539.155.2 *see Abstr.* 828

581.132 : 541.144.7 *see Abstr.* 867

## MEDICAL SCIENCE 61

612.7/.8 925

**The application of geophysical oscillographs to multiple recordings in physiology.** GARDNER, E., AND CRESCITELLI, F. *Science*, **102**, 452–4 (*Nov.* 2, 1945).

612.84 = 4 926

**Mechanism of stereoscopic vision.** RÖSCH, J. *Rev. Opt. (Théor. Instrum.)*, **22**, 65–84 (*April–June*, 1943). *In French.*—Discusses, almost entirely from the anatomical and physiological viewpoint, the mechanism of stereoscopic vision and the manner in which two eyes give a single impression. It is emphasized that a knowledge of this mechanism is important in the study of the perception of relief and in the exploitation of stereoscopic measurements. The application of such measurements is left for a further article. A. H.

612.85 : 534.773 *see Abstr.* 732

614.71 927

**Circulation in sanitary ventilation by bactericidal irradiation of air.** WELLS, W. F. *J. Franklin Inst.*, **240**, 379–95 (*Nov.*, 1945).

615.84 : 537.531.08 928

**A feed-back amplifier for ionization currents.** FARMER, F. T. *Brit. J. Radiol.*, **19**, 27–30 (*Jan.*, 1946).—A direct reading X-ray intensity meter comprising a small thimble chamber on the end of a flexible cable, and measuring dose rates of 1 to 50 r./min with a rapid response is described. A large degree of negative feed-back is used to stabilize against changes in valves and supply voltages, and gives a precision measuring device with a linear response to radiation intensity. Circuit details are given, and it is explained how, by simple switching, the instrument may be used to measure also small doses of X-rays such as occur in diagnostic work. [See Abstr. 529 B (1946)].

615.849 929

**Note on a function in the mathematical theory of integral dose.** NEARY, G. J. *Brit. J. Radiol.*, **18**, 401–2 (*Dec.*, 1945). *Erratum*, **19**, 87 (*Feb.*, 1946). [See Abstr. 870B (1945)].

615.849 : 537.531 930

**The development of Roentgen therapy during fifty years.** PFAHLER, G. E. *Radiology*, **45**, 503–21 (*Nov.*, 1945).—A general survey, including a bibliography of 69 entries.

615.849 : 621.386 : 537.531 931

**Fifty years of X-ray production and measurement in medical radiology.** OWEN, E. A. *Brit. J. Radiol.*, **19**, 369–76 (*Dec.*, 1945).

616-073.75 : 537.531 932

**The development of Roentgen diagnosis.** RIGLER, L. G. *Radiology*, **45**, 467–505 (*Nov.*, 1945).—A 50-year survey, including a bibliography of 226 entries.

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666.1 : 620.178.72 : 539.213.29 *see Abstr.* 842

666.24 : 656.25 : 535.66 *see Abstr.* 765

669.9 : 543 *see Abstr.* 875

678 : 620.172.212 : 539.389.3 *see Abstr.* 850

681 : 53.085.422 = 4 *see Abstr.* 675

681.4 : 535.8 = 4 *see Abstr.* 767

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77.019.2 : 537.531.9 *see Abstr.* 794

771.351.4 : 535.317 *see Abstr.* 742

778.3 : 535.411 *see Abstr.* 761

778.33 : 620.179.152 933

**Improved sensitivity in double-exposure radiography.** RIGBY, J. *Trans. Amer. Soc. Met.*, **35**, 536–48 (1945).—[Abstr. 480 B (1946)].

778.6 934

**Colour development: its history, chemistry and characteristics.** TULL, A. G. *Photogr. J.*, **85 B**, 13–24 (*Jan.–Feb.*, 1945).—The history of the process is outlined and then the subject is discussed under two main headings—primary and secondary colour development. The chief chemical characteristics are surveyed and an attempt is made at a general classification of colour couplers by chemical types. Other factors discussed are the influence of relative quantities of coupler and developing agent, the characteristics due to time of development, the ratio of dye produced to silver simultaneously developed (colour factor), fastness to light and washing, and the chemical stabilities of the developed dyes. A. H.